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# Part A

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## **Civil works**

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### Specifications

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## Civil Works – Specifications – Divisional Workshop

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## 0.0 General Note

- 1) Reference mentioned herein shall be applicable to all sections to the extent the context permits and are intended to supplement the provisions in the particular section. In case of any discrepancy/ deviation. The provisions in the particular section shall take precedence.
- 2) The rates for all items of work unless clearly specified otherwise, shall include cost of all labour, materials, machinery and other inputs involved in the execution of the items.
- 3) This SOR is based on CPWD specifications. The execution of items of this SOR is to be done as per CPWD specifications amended up to date and as per all applicable BIS codes and standards.

## 0.1 Interpretations

- 0.1.1 The Engineer-in-Chief, PWD Dharwad shall be the sole deciding authority as to the meaning, interpretation and implications for various provisions of the specifications. His decision in writing shall be final.
- 0.1.2 Wherever any reference is made to any Indian Standard, It shall be taken as reference to the latest edition will all amendments issued thereto. In the event of any variation between the specifications mentioned before the each chapter and the Indian Standard, than CPWD specifications shall be followed.

## 0.2 Definitions

The following terms and expressions in the specification shall have the meaning or implication hereby assigned to them unless otherwise specified elsewhere.

- 0.2.1 **Contractor:** The Contractor' shall mean the individual or firm or company whether incorporated or not undertaking the works and shall include the legal personal representatives of such individual or the persons composing such firm or company, or the successors of such individual or firm or company and the permitted assignees of such individual or firm or company.
- 0.2.2 **Engineer-in-Charge:** The 'Engineer-in-Charge' means the Engineer officer who shall supervise and be in charge of the work and who shall sign the contract on behalf of the Governor.
- 0.2.3 **Site:** The 'site' shall mean the land/ or other places, on or through which the work is to be executed under the contract or any adjacent land, path or street through which the work is to be executed under the contract, or any adjacent land, path or street which may be allotted or used for the purpose of carrying out the contract.
- 0.2.4 **Store:** The 'store' shall mean the place of issue of materials included in the appropriate schedule of a contract for issue by the PWD. In all other cases ' Store' shall mean any PWD store in the district.
- 0.2.5 **IS:** The standards, specification and Code of Practices issued by the Bureau of Indian Standards.
- 0.2.6 **Best:** The word 'best' when used shall mean that in the opinion of the Engineer-in-Charge, there is no superior material/ article and workmanship obtainable in the market and trade respectively. As far as possible the standard required shall be specified in preference to the word 'Best'.
- 0.2.7 **Department:** 'Department' shall mean Public Works Department or PWD.

## 0.3 Floor And Levels

### 0.3.1 Building

- 0.3.2 **Floor 1** is the lowest floor above the ground level in the building unless otherwise specified in a particular case. The floors above floor 1 shall be numbered in sequence as floor 2, floor 3 and so on. The number shall increase upwards.

0.3.3 **Floor level:** For floor 1, top level of finished floor shall be the floor level and for all other floors above floor 1. top level of the structural slabs shall be the floor level.

0.3.4 **Plinth level:** Floor 1 level or 1.2 m above the ground level whichever is lower shall be the plinth level.

### 0.3.5 **Special Structures:**

For structures like retaining walls, wing walls, chimneys, over head reservoirs/ tanks and other elevated structures, where elevations/ heights above a defined datum level have not been specified and identification of floors cannot be done as in case of building. Level, at 1.2 m above the ground level shall be the floor 1 level as well as plinth level. Level at a height of 4m above floor 1 level will be reckoned as floor 2 level and level at a height of 4 m above the floor 2 level will be floor 3 level and so on, where the total height above floor 1 level is not a whole number multiple of 4 meter. Top most floor level shall be the next in sequence to the floor level below even if the difference in height between the two upper most floor levels is less than 4 meters

## 0.4 **Foundation And Plinth**

The work in foundation and plinth shall include:

- (a) **For buildings:** All works up to 1.2 meter above ground level or up to floor 1 level whichever is lower.
- (b) **For abutments, piers and well steining:** All works up to 1.2 m above the bed level.
- (c) **For retaining wall, wing walls, compound walls, chimneys, over head reservoirs/ tanks and other elevated structures:** All works upto 1.2 metre above the ground level.
- (d) **For reservoirs/ tanks (other than overhead reservoirs/ tanks):** All works upto 1.2 meter above the ground level.
- (e) **For basements:** All works upto 1.2 m above ground level or upto floor 1 level whichever is lower.

**Note:** Specific provision shall be made in the estimate for such situations where the foundation level is more than 3 (three) metre depth from the plinth for all types of structures mentioned above.

## 0.5 **Measurements**

0.5.1 In booking dimensions, the order shall be consistent and in the sequence of length. Width and height or depth or thickness.

0.5.2 **Rounding off:** Rounding off where required shall be done in accordance with IS: 2-1960. The number of significant places rounded in the rounded off value should be as specified.

## 0.6 **Materials**

0.6.0 Samples of all materials to be used on the work shall be got approved by the contractor from the Engineer-in-Charge well in time. The approved samples duly authenticated and sealed shall be kept in the custody of the Engineer-in-Charge till the completion of the work. All materials to be provided by the contractor shall be brand new and as per the samples approved by the Engineer-in-Charge

0.6.1 Mandatory tests are required to be carried out as per relevant IS: code. Testing of samples shall be done in the laboratory approved by the Engineer-in-Charge.

0.6.2 Materials obtained by the contractor from the sources approved by the Department shall be subjected to the Mandatory tests, where such materials don not conform to the relevant specifications. The matter shall be taken up by the Engineer-in-Charge for appropriate action against the defaulters. In all such cases, necessary documents in original and proof of payment relating to the procurement of materials shall be made available by the contractor to the Engineer-in-Charge.

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- 0.6.3 Samples, whether submitted for approval to govern bulk supplies or required for testing before use and also the samples of materials bearing 'Standard mark,' if required for testing shall be provided free of cost by the contractor. All other incidental expenditure to be incurred for testing of samples e.g. packaging sealing transportation. Loading unloading etc. except testing charges for conducting test as per 0.8.5, 0.8.6 ,0.8.7 if any, shall be borne by the contractor.
- 0.6.4 The materials, supplied by the Department shall be deemed to be complying with the specifications.
- 0.6.5 Materials stored at site, depending upon the individual characteristics, shall be protected from atmospheric effects due to rain, sun, wind and moisture to avoid deterioration.
- 0.6.6 Materials like timber. Paints etc. shall be stored in such a way that there may not be any possibility of fire hazards. Inflammable materials and explosives shall be stored in accordance with the relevant rules and regulations or as approved by Engineer-in-Charge in writing so as to ensure desired safety during storage.
- 0.6.7 The unit weight of materials unless otherwise specified shall be reckoned as given in IS: 1911-1967.

### **0.7 Wages To Labour:**

The contractor shall be bound to pay the wages to the labourers, as per minimum wages act, rule and other instructions issued by State Govt. from time to time.

### **0.8 Safety In Construction**

The contractor shall employ only such methods of construction tools and plant as are appropriate for the type of work or as approved by Engineer-in-Charge. If the contractor fails to comply the orders of Engineer-in-Charge/ department with respect to safety measures, if any untoward incidents happens contractors will be solely responsible.

The contractor shall take all precautions and measures to ensure safety of works and workman and shall be fully responsible for the same. Safety pertaining to construction works such as excavation centering and shuttering, trenching, blasting demolition, scaffolds, ladders working platforms, gangway, mixing of bituminous materials, electric and gas welding use of hoisting and construction machinery shall be governed by PWD specifications, CPWD specification, relevant safety codes and the direction of Engineer-in-Charge



## C.2 Earth Work

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### 2.1 Definitions

**Deadmen or Tell Tales:** Mounds of earth left undisturbed in pits dug out for borrowing earth

**Burjis:** Short pillars of brick/ stone having top surface finished with cement plaster for marking etc.

**Formation or Profile:** Final shape of the ground after excavation or filling up.

**Foul position:** Filthy and unhygienic conditions where physical movements are hampered such as soil mixed with sewage or night soil.

**Lead:** The distance for removal, measured over the shortest practicable route and not necessarily the route actually taken.

**Liquid mud:** Mud in liquid form or in a highly plastic state.

**Lift:** The vertical distance for removal with reference to the ground level. The excavation up to 1.5 metres depth below the ground level and depositing the excavated materials upto 1.5 metres above the ground level are included in the rate of earth work. Lifts inherent in the lead due to ground slope shall not be paid for.

**Safety rules:** Safety rules as laid down by the statutory authority.

### 2.2 Classification Of Soils Excavated Materials

The earthwork shall be classified under the following categories and measured separately for each category:

**(a) All kind of soils:** Generally any strata, such as sand, gravel, loam, clay, mud, black cotton moorum, shingle, river or etc. and hard core, macadam surface of any description (water bound, grouted tarmac etc.), Lime concrete mud concrete and their mixtures which for excavation yields to application of picks. Showels, jumper, sacrificers, ripper and other manual digging implements.

**(b) Ordinary rock:** Generally any rock which can be excavated by splitting with crow bars or picks and does not require blasting, wedging or similar means for excavation varieties of lime stone, sand stone, hard laterite hard conglomerate and unreinforced cement concrete below ground level. Also any rock which in dry state may be hard requiring blasting but which , when wet, becomes soft and manageable by means other than blasting:

If required light blasting may be resorted to for loosening the materials but this will not in any way entitle the material to be classified as 'Hard rock'.

**(c) Hard rock:** Generally any rock or boulder for the excavation of which blasting is required such as quartzite, granite, basalt, reinforced cement concrete (reinforcement to be cut through but not separated from concrete) below ground level and the like.

**(d) Hard rock (blasting prohibited):** Hard rock requiring blasting as described under (c) but where the blasting is prohibited for any reason and excavation has to be carried out by chiseling wedging or any other agreed method.

**(e) Authority for classification:** The classification of excavation shall be decided by the Engineer-in-charge and his decision shall be final and binding on the Contractor. Merely the use of explosives in excavation will not be considered as a reason for higher classification unless blasting is clearly necessary in the opinion of the Engineer-in-charge.

**(f) Execution**

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All excavation operations shall include excavation and 'getting out' the excavated materials. The excavations shall conform to the lines & levels shown in the drawings and as directed by the Engineer-in-Charge. The contractor shall not excavate outside the limits of excavation. Any excess depth/width, excavated beyond the specified levels/ dimensions on the drawing shall be made good at the cost of the contractor with the same material or good earth as decided by the Engineer-in-Charge.

Excavation can be done by mechanical or manual means as per choice/ ease of contractor and conditions of site.

In firm soils the sides of the trenches shall be kept vertical upto a depth of 2 metres from the bottom. For greater depths, the excavation profiles shall be widened by allowing steps of 50 cms on either side after every 2 metres from the bottom. Alternatively, the excavation can be done so as to give slope of 1:4 (1 horizontal: 4 vertical). Where the soil is soft loose or slushy, the width of steps shall be suitably increased or sides sloped or the soil shored up as directed by the Engineer-in-Charge.

The water that may accumulate in excavations during the progress of the work from springs, Tidal or river seepage, Broken water mains or drains (not due to the negligence of the contractor) and seepage from subsoil aquifer shall be bailed, pumped out or otherwise removed.

Excavation where directed by the Engineer-in-Charge shall be securely fenced and provided with proper caution signs, conspicuously displayed during the day and properly illuminated with red lights during the night to avoid accidents.

In case of Archaeological monuments within or adjacent to the area. The contractor shall provide necessary fencing around such monuments as per the directions of the Engineer-in-Charge and protect the same properly during execution of works. Payment for providing fencing shall be made separately.

The ground levels, where ever required, shall be taken at 5 to 15 metres intervals (as directed by the Engineer-in-Charge) in uniformly sloping ground and at closer intervals where local mounds, pits or undulations are met with. The ground levels shall recorded in field books and plotted on plans. The plans shall be drawn to a scale of 5 metres to one cm or any other suitable scale decided by the Engineer-in-Charge. North direction line and position of bench mark shall invariable be shown on the plans. These plans shall be signed by the contractor and the Engineer-in-Charge or their authorized representatives before the earth work is started The labour required for taking levels shall be supplied by the contractor at his own cost.

### **(g) Blasting Operation**

Blasting shall be carried out in a manner that completes the excavation to the lines and levels as indicated in the drawings with the least disturbance to adjacent material. It shall be done only with the written permission of the Engineer-in-Charge. All statutory laws, regulation, rules etc. pertaining to the acquisition, transport, storage, handling and use of explosives shall be strictly followed.

The contract may adopt any method or methods of blasting consistent with the safety and job requirements, Prior to starting any phase of the operation, the contractor shall provide information describing pertinent blasting procedures, dimension and notes.

The magazine for storage of explosives shall be limited to the designs and specification of the explosive department concerned and located at the approved site.

No unauthorized person shall be admitted in to the magazine, which when not in use, shall be kept security locked, No matches boxes or inflammable material shall be allowed in the magazine. Materials, tools, plants, equipments and personnel, deputed on blasting operation, should be approved by Engineer-in-Charge.

### **(h) Antiquites And Useful Materials**

Any ancient carvings, relics of antiquity, coins, fossils or other articles of value curiosities which may be discovered or excavated, are the property of the Government and are to be delivered to the Engineer-in-Charge

Any material obtained from the excavation which in the opinion of the Engineer-in-Charge is useful, shall be stacked separately in regular stacks as directed by the Engineer-in-Charge and shall be the property of the Government.

## **2.3 Measurements**

- (a) Measurement shall be done for excavation/ refilling as per dimensions shown in the drawings or as per modified dimensions or as per direction by the Engineer-in-charge. The length and breadth of excavation or filling shall be measured with a steel tape correct to the nearest cm. The depth of cutting or height of filling shall be measured correct to 5 mm by measuring with steel tape or by recording levels before the start of the work and after the completion of the work, as decided by Engineer-in-Charge.
- (b) The calculated quantity of volume will be in cum and of area in square metre correct upto two decimals

## **2.4 Rates**

Rates of all items in this chapter are inclusive of the expenses of all labour, materials, hire & running expenses of all tools & machineries and all incidental and other charges required to complete the item of work in full.

### **C.3 Anti Termite Treatment**

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IS 6313 code shall be followed for the execution of all the Anti- termite works.

Part 1 Code of practice for anti-termite measures in buildings: constructional measures

Part 2 Code of practice for anti termite measures in buildings: Pre constructional chemical treatment measures

Unless otherwise mentioned the specifications as mentioned in the Bill of Quantities shall be followed in conjunction with the specifications mentioned in the SOR for Dharwad and CPWD specifications of New Delhi.

Method of Measurement : Measurements shall be measured to the nearest square meter area (m<sup>2</sup>) as per the norms of SP 27 Hand book of method of measurement of building works.

## C.4 Form Work

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### 4.1 Scope

Formwork shall include all temporary or permanent forms or moulds required for forming the concrete of the shape, dimensions and surface finish as shown on the drawings together with all props, staging, centering, scaffolding and temporary construction required for their support upto a floor height of 4.0 metre.

### 4.2 Material Used In Form Work

- i) Form shall be constructed with metal. However the form work top surface with water proof can also be used. The metal used for forms shall be such thickness that the forms remain true to shape. All bolts should be counter sunk.
- ii) All materials (For which BIS specifications/ Standards are available) shall conform to the specifications issued by the Bureau of Indian Standards. All other material shall be of good quality and sufficient strength that the forms remain true to shape. All bolts should be counter sunk.
- iii) Materials and components used for formwork shall be examined before use/ reuse for damage or excessive deterioration and shall be used only if found suitable after necessary repairs. In case of timber form work, the inspection shall also cover physical damages, signs of attacks by decay, rot or insect or the development of splits. The materials used should not leave any stain on the concrete and so fixed to its backing as not to impart any blemishes.
- iv) The formwork shall be robust and strong and joints shall be leak proof. Staging must have cross bracings and diagonal bracings in both direction and the number of joints in the form work shall be kept to a minimum by using large size panels.

### 4.3 Design Of Form Work:

The contractor shall furnish the design and drawings of complete formwork (i.e. the forms as well as their supports) for approval of the Engineer-in-Charge before any erection is taken up. Notwithstanding any approval or review of drawing and design by the Engineer-in-Charge, the contractor shall be entirely responsible for the adequacy and safety of form work. Form work shall be designed and constructed to the shapes, lines and dimensions shown on the drawings with the tolerances given below:

S N o	Location	Tolerance
1	Deviation from specified dimension of cross section of columns and beams	+ 12mm
2	Deviation from specified dimension of footings. a) Dimension in plan b) Eccentricity in plan	+ 50mm 0.02 times the width of the footing in the direction of deviation but not more than 50mm

c)	Thickness	+0.05 times the specified thickness
NOTE: Tolerances apply to concrete dimension only and not to positioning of steel or dowels.		

#### 4.4 Removal Of Form Work (Stripping Time)

In normal circumstances and where ordinary Portland cement is used, forms may generally be removed after the expiry of the following periods:

S No	Location	Tolerance
a)	Walls, columns and vertical faces of all structural members	24 to 48 hours as may be decided by the Engineer-in-Charge
b)	Slab i) Spanning upto 4.50 M ii) Spanning over 4.50 M	7 days 14 days
c)	Beams and arches i) Spanning upto 6 M ii) Spanning over 6 M & Upto 9 M iii) Spanning over 9M	14 days 21 days 28 days

#### Note-

- i) For other types of cement, the stripping time recommended for ordinary Portland cement may be suitably modified. If Portland slag or low heat cement has been used for concrete, the stripping time will be 10/7 of the period stated above.
- ii) The number of props left under, their sizes and disposition shall be such as to be able to safely carry the full dead load of the slabs, beam or arch as the case may be together with any live load likely to occur during curing or further construction.
- iii) For rapid hardening cement, 3/7 of above periods will be sufficient in all cases except for vertical side of slabs, beams and columns which should be retained for atleast 24 hours.
- iv) In case of cantilever slabs and beams, the centering shall remain till structures for counter acting or bearing down have been erected and have attained sufficient strength.
- v) Proper precautions should be taken to allow for the decrease in the rate of hardening that occurs with all types of cement in cold weather and accordingly stripping time shall be increased.
- vi) Work damaged through premature or careless removal of forms shall be reconstructed.

#### 4.5 Surface Treatment

Shuttering surfaces should be coated with suitable mould oil, which acts both as a parting agent and also give surface protections to shuttering.

After 3-4 used and also in cases when shuttering has been stored for a long time, it should be recoated with mould oil before the next use.

A typical mould oil is heavy mineral oil or purified cylinder oil containing not less than 5% pentachlorophenol conforming to IS 716- 1987 well mixed to a viscosity of 70-80 centipoises.

Lubricating (machine oils) are prohibited for use as a coating.

## **4.6 Measurement**

Measurements shall be taken of the area of shuttering in contact with the concrete surface. No deductions from the shuttering due to openings/ obstruction shall be made if the area of such openings/ obstructions does not exceed 0.1 sqm. Nothing extra shall be paid for forming such openings

Dimensions in form work shall be measured in metre upto two place of decimal (cm). The area should be calculated in square metre correct to two decimal. 0.01 sqm).

Where height of form work is more than 4.0 metre in one floor, extra payment for additional height shall be made.

## **4.7 Rates**

Rates in this chapter are for the finished work including the cost of all materials, labour, tools and plant required for design, construction and removal of formwork at all levels including properly supporting the members until the concrete is cured, set and hardened as required and also inclusive of lining with material approve by the Engineer-in-Charge so as to provide a smooth finish of uniform texture, appearance and to produce a finished concrete true to shape, line, levels and dimension as shown on the drawings. The rate also included coating of formwork with an approved release agent that will effectively prevent sticking and will not stain the concrete surface. Rates also include all leads and lifts of all materials etc. required for the work

## **C.4 Cement Concrete (Plain And Reinforced)**

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### **4.1 Materials**

#### **4.1.1 Cement**

Cement to be used in the works shall be any of the following types with the prior approval of the Engineer-in-Charge:

- a) Ordinary Portland cement, 43 Grade conforming to IS: 8112.
- b) Ordinary Portland cement, 53 Grade conforming to IS: 12269.
- c) Sulphate resistant Portland cement conforming to IS: 12330.
- d) Portland slag cement conforming to IS: 455.
- e) Rapid Hardening cement conforming to IS: 8041

P.P.C cement is not allowed at all for use in any work. Different types of cement shall not be mixed together. In case more than one type of cement is used in any work, a record shall be kept showing the location and the types of cement used.

#### **4.1.2 Steel**

Steel to be used shall conform to the following:

- a) Mild steel and medium tensile bars confirming to IS: 432 : (Part I-1982).

- b) Hard drawn steel wire conforming to IS: 432:Part-II-1982
- c) High strength deformed steel bars IS:1786:1985
- d) Hard drawn steel wire fabric IS: 1566:1982
- e) TMT

All steel shall be procured from original producers, no re-rolled steel shall be used in the work.

Only new steel shall be delivered to the site. Every bar shall be inspected before assembling on the work and defective, brittle or burnt bar shall be discarded. Cracked ends of bars shall be discarded.

Steel for reinforcement shall be stored in such a way as to prevent distorting and corrosion at sites. Bars of different type, sizes and length to be stored separately

### 4.1.3 Coarse Aggregates

Coarse aggregate shall consist of clean, hard, strong, dense, non-porous and durable pieces of crushed stone. They shall not consist of disintegrated stones, soft, flaky, elongated particles, salt, alkali, vegetable matter or other deleterious materials. All coarse aggregate shall conform to IS: 383:1970 and tests for conformity shall be carried out as per IS: 2386:1963 I to VIII.

The maximum value of flakiness Index for coarse aggregate shall not exceed 35 percent. The coarse aggregate shall satisfy the following requirements of grading;

#### Grading Requirements of Coarse Aggregate

IS Sieve Designation	Percent passing (by weight) for nominal size of			
	40mm	20mm	16mm	12.5 mm
75 mm	100	-	-	-
37.5 mm	95 to 100	100	-	-
19 mm	30 to 70	95 to 100	100	100
16 mm	-	-	90 to 100	-
11.2 mm	-	-	-	90 to 100
9.5 mm	10-35	25 to 55	30 to 70	40 to 85
4.75 mm	0 to 5	0 to 10	0 to 10	0 to 10
2.36 mm	-	-	-	-

### 4.1.4 Sand/ Fine Aggregates

Fine aggregates shall not contain dust, lumps, soft or flaky materials, mica or other deleterious materials. Fine aggregates having positive alkali-silica reaction shall not be used. All fine aggregate shall conform to IS: 383. The fineness modulus of fine aggregate shall neither be less than 2.0 nor greater than 3.5 the fine aggregate should satisfy the following grading requirement.

#### • Table

IS Sieve	Percentage passing for			
	Grading Zone I	Grading Zone II	Grading Zone III	Grading Zone IV
9.50 mm	100	100	100	100



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4.75 mm	90-100	90-100	90-100	92-100
2.36 mm	60-95	75-100	85-100	95-100
1.18 mm	30-70	55-90	75-90	90-100
600 micron	15-34	35-59	60-79	80-100
300 micron	5-20	8-30	12-40	15-50
150 micron	0-10	0-10	0-10	0-15

### 4.1.5 Water

Water used for mixing and curing shall be clean and free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete. Potable water is generally considered satisfactory for mixing and curing of concrete.

### 4.1.6 Concrete

Design mix Concrete, mixed in a batching and mixing plant shall generally be used. Ready Mix concrete manufactured by reputed/ approved manufacture may also be used.

Concrete with nominal mix, mixed in mechanical concrete mixer may be permitted by Engineer-in-charge in case of small quantity of concrete and in remote locations. Hand mixing is strictly prohibited.

Mixing shall be continued till materials are uniformly distributed and a uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate shows complete coating of mortar, containing its proportionate amount of cement. In no case, mixing shall be done for less than 2 minutes.

Design mix Concrete shall be mixed with cement contents as per design or minimum required as per table below.

**TABLE-1**

Concrete Mix	Minimum Cement per cum of concrete	Specified characteristics compressive strength at 7 days	Specified characteristics compressive strength at 28 days
M-20	390 kg	13.5 N/mm <sup>2</sup>	20 N/mm <sup>2</sup>
M-25	410 kg	17.0 N/mm <sup>2</sup>	25 N/mm <sup>2</sup>
M-30	420 kg	20.0 N/mm <sup>2</sup>	30 N/mm <sup>2</sup>
M-35	428 kg	23.5 N/mm <sup>2</sup>	35 N/mm <sup>2</sup>
M-40	435 kg	26.5 N/mm <sup>2</sup>	40 N/mm <sup>2</sup>

Nominal mix concrete shall be mixed in concrete mixer with weighted quantity of cement, sand and aggregate in the ratio as per table No 2 below.

**TABLE-2**

Concrete Mix	Cement (Kg)	Sand (Kg)	Aggregate (Kg)	Size of aggregate
M-5	1 Bag (50 kg)	230	570	40mm
M-7.5	1 Bag (50 kg)	180	445	40mm
M-10	1 Bag (50 kg)	140	340	40mm
M-10	1 Bag (50 kg)	160	320	20mm

M-15	1 Bag (50 kg)	110	220	20mm
M-20	1 Bag (50 kg)	85	165	20mm

In case where arrangement of correct weighting of sand, aggregate is not available/possible the concrete shall be mixed in concrete mixer in volumetric ratio as specified in item. The minimum compressive strength on works test for different concrete mixes shall be as specified for various grades prepared by volume basis, in Table 3 below:

**TABLE -3**

Concrete mix on	Min compressive strength 15cm cube in kg/cm <sup>2</sup>	
	7days	28 days
1:1:2	210	315
1:1 <sup>1</sup> / <sub>2</sub> :3	175	265
1:2:4	140	210

Concrete shall be transported and placed as near as practicable to its final position. Concrete shall not be freely dropped into place from a height exceeding 1.50 meters and it shall be compacted in its final position within 30 minutes of its discharge from the mixer. It shall be compacted thoroughly by vibration or other means during placing so as to produce a dense homogeneous void-free mass having the required surface finish.

Bottom and side surfaces shall give a uniform texture, smooth surface and good appearance. Non uniform texture and rough surface of concrete shall be treated as defective work and it has to be remedied with 1:3 cement plaster but in no case, more than 5% of area be permitted to be made good with plastering. Concrete having rough, non uniform texture and honey combing in more than 5% area shall be rejected and the payment for the formwork shall also be not made.

## 4.2 Construction Joints

- a) Concreting shall be carried out continuously upto the construction joints, the position and details of which shall be as shown in structural drawing or as directed by Engineer-in-Charge. Number of such joints shall be kept to minimum. The joints shall be kept at places where the shear force is the minimum. These shall be straight and shall be at right angles to the direction of main reinforcement.
- b) In case of columns the joints shall be horizontal and 10 to 15 cm below the bottom of the beam running into the column head. The portion of the column between the stepping off level and the top of the slab shall be concreted with the beam.
- c) When stopping the concrete on a vertical plane in slabs and beams, an approved stop-board shall be placed with necessary slots for reinforcement bars or any other obstruction to pass the bars freely without bending. The construction joints shall be keyed by providing a triangular or trapezoidal fillet nailed on the stop-board. Inclined or feather joints shall not be permitted. Any concrete flowing through the joints of stop-board shall be removed soon after the initial set. When concrete is stopped on a horizontal plane, the surface shall be roughened and cleaned after the initial set.
- d) When the work has to be resumed, the joint shall be thoroughly cleaned with wire brush and loose particles removed. A coat of neat cement slurry at the rate of 2.75 kg of cement per square metre shall then be applied on the roughened surface before fresh concrete is laid.

## 4.3 Expansion Joints

Expansion joints shall be provided as shown in the structural drawing or as directed by Engineer-in-Charge, for the purpose of general guidance. However it is recommended that structures exceeding 45 m in length shall be divided by one or more expansion joints. The filling of the joints with bitumen filler,

bitumen felt or any such material and provision of copper plate, etc. shall be paid for separately in running metre. The measurement shall be taken upto two places of decimal stating the depth and width of joint.

#### **4.4 Under Water Concreting**

Concrete shall not be deposited under water if it is practicable to de-water the area and place concrete in the regular manner. The concrete shall contain at least 10% more cement than that required for the same mix placed in dry conditions, the quantity of extra cement varying with conditions of placing with prior written permission of the Engineer-in-Charge. Such extra cement will be paid extra. The volume of coarse aggregate shall not be less than 1-1/2 times nor more than twice the fine aggregate and slump not less than 100 mm nor more than 180mm. Where found necessary to deposit any concrete under water, the method, equipment, materials and mix shall first be got approved by the Engineer-in-Charge. Concrete shall be deposited continuously until it is brought to required height. While depositing, the top surface shall be kept as nearly level as possible and the formation of heaps shall be avoided. The concrete shall be deposited under water by one of the approved methods such as tremie method, drop bottom bucket, bags, grouting etc. as per details given in IS 456-1975. If it is necessary to raise the water after placing the concrete, the level shall be brought up slowly without creating any waves or commotion tending to wash away cement or to disturb the fresh concrete in any way.

#### **4.5 Curing**

After the concrete has begun to harden i.e. about 1 to 2 hours after its laying, it shall be protected from quick drying by covering with moist gunny bags, sand, canvass Hessian or any other material approved by the Engineer-in-Charge. After 24 hours of laying of concrete, the surface shall be cured by ponding with water for a minimum period of 7 days from the date of placing of concrete in case of OPC and at least 10 days where mineral admixtures of blended cements are used. The period of curing shall not be less than 10 days for concrete exposed to dry and hot weather condition.

#### **4.6 Mandatory Tests**

The testing of materials shall be carried out as per relevant IS: code

#### **4.7 Measurements**

Height of one storey will be considered 4.0 metre. In case ceiling height is more than 4.0 metre in one storey, then the work executed beyond the 4.0m height will be treated in next storey and payment for all items will be made accordingly.

##### **A) Cement concrete/ Reinforced cement concrete**

Dimension shall be measured nearest to a cm except for the thickness of slab which shall be measured correct to 0.5cm. The cubical contents shall be worked out nearest 0.01 Cum. No deductions shall be made for following:

- (a) Ends of dis-similar materials (e.g. joists, beams, postgridders, rafters, purlians, trusses, corbels steps etc.) upto 500 sq.cm. in cross section.
- (b) Opening upto 0.10 sqm (In calculating area of openings upto 0.1 sqm the size of the opening shall include the thickness of any separate lintels or sills. No extra labour for forming such opening of voids shall be paid for.
- (c) The volume occupied by reinforcement
- (d) The volume occupied by water pipes, conduits etc not exceeding 25sq.cm. each in cross-sectional area nothing extra shall be paid for leaving and finishing such cavities and holes.

**B) Reinforcement:** The reinforcement including authorized spacer bars and overlaps shall be measured in lengths of different diameters, as actually used in works nearest to a centimeter and their weight calculated on the basis of coefficient as per standard table given below. Wastage and un-authorized overlaps shall not be paid for.

**Cross Sectional Area and Mass of Steel Bar as per IS: 1786-1985 (clause 5.2)**

Nominal Size mm	Cross Sectional Area Sq.mm	Mass per metre Run kg
6	28.3	0.222
8	50.3	0.395
10	78.6	0.617
12	113.1	0.888
16	201.2	1.58
18	254.6	2.00
20	314.3	2.47
22	380.3	2.98
25	491.1	3.85
28	616.0	4.83
32	804.6	6.31
36	1018.3	7.99
40	1257.2	9.85
45	1591.1	12.50
50	1964.3	15.42

## 4.8 Rates

- a) **Cement concrete/ Reinforced cement concrete:** The rate includes the cost of all the machinery, materials and labour involved except the cost of form work and reinforcement.
- b) **Reinforcement:** The Rate includes the cost of reinforcement and all tools, labour and materials required for all operations such as cleaning of reinforcement bars, straightening, cutting, hooking, bending, placing in position, binding and binding wires etc. as required or as directed including tack welding on crossing of bars in lieu of binding with wires.

## **C.5 Water Proofing**

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### **5.1 General**

Water proofing means to make the structure leak proof. The appropriate water proofing material should be used for water proofing depending upon the location and situation of the structure.

Every water proofing treatment should be guaranteed for 5 years by the contractor from the date of completion of water proofing treatment in prescribed guarantee bond as given at the end of this chapter.

### **5.2 Materials**

The materials to be used in the water proofing treatment should be as specified in the item. Water proofing compound in powder form manufactured by reputed manufacturer like Cico, Impermo etc. bearing ISI mark conforming to IS 2645 should be mixed with the contents of each bag, as specified in item. The quantity of water proofing compound to be mixed should be as prescribed by the manufacturer but not exceeding 3% by weight of cement.

### **5.3 Preparation Of The Surface**

The surface where the water proofing treatment is to be applied should be thoroughly cleaned with the wire brush. However for the basement water proofing, the surface should be roughened by hacking the surface with a specially made hacking tool immediately after initial set takes place in the concrete. Hacking the already hardened surface of richer mix concrete will not be possible and in that case the key required to be provided for the base course to be laid on top, shall be done by providing spatter dash key. Under no circumstances the water proofing treatment shall be done on a plain surface or a surface simply scratched with wire brushes etc.

The surface to be treated with Bitumen Felts/ APP shall have a minimum slope of 1 in 120. This grading shall be carried out with cement concrete or cement plaster with coarse sand, as ordered, to the average thickness required and finished smooth. Such grading shall be paid for separately. Junctions between the roof and vertical faces of parapet walls, chimneys etc. shall be cased by running triangular fillets 7.5x7.5 cm size, in cement concrete. At the drain mouths, the fillets shall be suitable cut back and rounded off for easy application of water proofing treatment and easy flow of water.

### **5.4 Laying**

After preparation of surface the water proofing treatment should be laid in layers and with the material as specified in the nomenclature of items.

### **5.5 Curing**

For basement water proofing on completion of water proofing courses from outside, the surface shall be cleaned scaffolding shall be removed and curing should be started by sprinkling water. The exposed faces of the water proofing course shall be kept wet for 14 days. No back filling shall be done before expiry of 14 days from the date of completing the water proofing course from outside.

### **5.6 Measurement**

For area length and breadth shall be measured along the finished surface correct to a cm and area shall be worked out to nearest square metre nearest to two decimal. The measurement shall be taken along the finish surface of treatment including the rounded and taper portion at junction of parapet wall. Overlaps shall not be measured.

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For volume length and breadth shall be measured along the finished surface correct to a cm and thickness shall be measured correct to 5mm and the cubical contents of consolidated concrete/mortar shall be worked out in cum with 3 places of decimal i.e. 0.001 cum. For grading items concrete/ mortar laid in excess of the dimension shown in the drawing shall not be measured.

No deduction in measurement shall be made for either openings or recesses or chimney stack, roof lights or Khurras or area upto 0.40 sqm, nor any thing extra shall be paid for forming such openings, recesses etc. For areas exceeding 0.40 sqm deduction will be made in the measurement for the full openings and nothing extra shall be paid for making such openings.

Length shall be measured correct to a cm and net quantities shall be calculated up to two places of decimal for water stops

### **5.7 Rate**

The rates include cost of all materials, labour, T & P, wastages, water for curing, hire & running charges of all type of machineries required and all lead & lifts of all materials etc. complete

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## C.6 Brickwork & Mortars

### 6.1 Materials

#### 6.1.1 Cement

Cement to be used in the work, shall be either ordinary Portland cement 33 grade conforming to IS: 269 or ordinary Portland cement 43 grade conforming to IS: 8112.

#### 6.1.2 Sand

Sand to be used in mortar for plaster work shall conform to IS: 1542-1977 and for masonry and flooring work shall conform to IS 2116-1980.

Nothing extra, is permissible on account of use of Narmada Sand or sand brought from any other river/ quarry and the sand brought from Narmada shall also be allowed to be used only, when it conforms to the requirements of IS: 1542-1977 and IS:2166-1980. Sand for use in masonry and plaster mortar should fulfill the following grading requirements.

Grading of sand for use in masonry mortar (coarse sand) as per IS: 2116-1980

IS Sieve Designation	Percentage passing by mass	Ref to method of test
4.75 mm	100	
2.36 mm	90 to 100	IS: 2386 (Part I)-1963
1.18 mm	70 to 100	
600 micron	40 to 100	
300 micron	5 to 70	
150 micron	0 to 15	

Grading of sand for use in plaster mortar (fine sand) as per IS: 1542-1977

IS Sieve Designation	Percentage passing by mass
10 mm	100
4.75 mm	95-100
2.36 mm	95-100
1.18 mm	90-100
600 micron	80-100
300 micron	20-65
150 micron	0-50

#### 6.1.3 Water

Water used for mixing and curing shall be clean and free from injurious quantities of oils, acids, alkalis, salts, sugar, organic vegetable growth or other substances that may be deleterious to bricks, stone, concrete or steel. Potable water is generally considered satisfactory for preparing mortars. The water used for work should be in accordance with IS: 3025-1986.

### 6.1.4 Cement Mortar

Cement and sand shall be mixed in specified proportions given in the agreement/ drawings. All mortars shall be mixed with a minimum quantity of water to produce desired work-ability consistent with maximum density of mortar. The mix shall be clean and free from injurious type of soil/acid/alkali/organic matter or deleterious substances.

The mixing shall preferably be done in a mechanical mixer operated manually or by power. Hand mixing can be resorted to as long as uniform density of the mix and its strength are assured subject to prior approval of the Engineer-in-Charge. Hand mixing operation, if permitted, shall be carried out on a clean water tight platform where cement and sand shall be first mixed dry in the required proportion by being turned over and over, backwards and forwards several times till the mixture is of uniform colour. Thereafter, minimum quantity of water shall be added to bring the mortar to the consistency of stiff paste. The mortar shall be mixed for at least two minutes after addition of water.

Mortar shall be mixed only in such quantity as required for immediate use. The mix which has developed initial set, shall not be used. Initial set of mortar with O.P.C. shall normally be considered to have taken place in 30 minutes after mixing. If the mortar has stiffened during initial setting time because of evaporation of water, same can be re-tempered by adding water as frequently as needed to restore requisite consistency but this retempering shall not be permitted after 30 minutes. Mortar, unused for more than 30 minutes, shall be rejected and removed from site.

## 6.2 Stone Work

### 6.2.1 General

- i) The work shall consist of construction of structures with stone jointed together by cement mortar in accordance with the details shown on the drawings.
- ii) Stones shall be of the type specified. It shall be hard, sound, free from cracks, decay and weathering and shall be freshly quarried from an approved quarry. Stone with round surface shall not be used.
- iii) The stones, when immersed in water for 24 hours, shall not absorb water by more than 5 percent of their dry weight when tested in accordance with IS: 1124.
- iv) The length of stones shall not exceed three times its height nor shall they be less than twice its height plus one joint. No stone shall be less in width than the height and the width. On the base shall not be greater than three-fourth of the thickness of the wall nor less than 150mm.
- v) The type of masonry used for the structures shall be random masonry (Coursed or uncoursed) or Coursed rubble masonry (Second Sort).

### 6.2.2 Surfacing Or Dressing Of Stones

The dressing of stone shall be as specified for individual type of masonry work and it shall also conform to the general requirements of IS: 1597 and requirements for dressing of stone covered in IS: 1129.

- i) **R.R. Masonry** : Each stone shall be hammer dressed on the face, the sides and the bed. Hammer dressing shall enable the stones to be laid close to neighbouring stones such that the bushing in the face shall not project more than 40 mm on the exposed full and 10 mm on the full to be plastered.
- ii) **Course Rubble Masonry**: Face stones shall be hammer dressed on all beds, and joints so as to give them approximately rectangular block shape. These shall be squared on all joints and beds. The bed joint shall be rough chisel dressed for atleast 8cm back from the face, and side joints for at least 4cm such that no portion of the dressed surface is more than 6 mm from a straight edge placed on it. The bushing on the face shall not project more than 4cm as an exposed face and one cm. on a face to be plastered. The hammer dressed stone shall also have a rough tooling for minimum width of 2.5cm along the four edges of the face of the stone, when stone work is exposed.



- iii) **Plain ashlar masonry:** Every stone shall be cut to the required size and shape, so as to be free from waviness and to give truly vertical and horizontal joints. In exposed masonry, the faces that are to remain exposed in the final position and the adjoining faces to a depth of 6mm shall be the fine chisel dressed so that when the checked with 60 cm straight edge, no point varies from it by more than 1mm. The top and bottom faces that are to form the bed joints shall be chisel dressed so that variation from 60 cm straight edge at no point exceeds 3 mm. Faces which are to form the vertical joints should be chisel dressed so that variation at any point with 60cm straight edge does not exceed 6mm. any vertical face that is to come against backing of masonry shall be dressed such that variation from straight edge does not exceed 10mm. All angles and edges that are to remain exposed in the final position shall be true, square and free from chippings.
- iv) **Punched ashlar masonry:** Shall be as specified in plain Ashlar masonry (iii) except that the faces exposed in view shall have a fine dressed chisel draft 2.5 cm wide all round the edges and shall be rough tooled between the drafts, such that the dressed surface shall not be more than 3mm from a straight edge placed over it.
- v) **Stone veneering work:** Shall be as specified plain Ashlar masonry (iii) except that dressing at the back shall not be done, so as to ensure better grip with the hearting or backing. The dressed slabs shall be of the thickness as specified, with permissible tolerance of 2mm.

A sample of dressed stone shall be prepared for approval of Engineer-in-Charge. It shall be kept at the worksite as a sample after being approved.

### 6.2.3 Terminology In Stone Dressing

The stones are dressed to have different surfaces as indicated below.

**Template or Bed Block** - A block of stone or concrete bedded on a wall to distribute the pressure from a concentrated load.

**Self Face Surface** - Surfaces of stone slabs used for roofing flooring, lintels etc. as obtained from quarry.

**Squared Back Surface** - Means the surface shall be dressed back at right angles to the face of the stone.

**Chisel Drafted Margin** - The dressing done with a drafting chisel in narrow strips of width generally 2 to 5 cm. Chisel drafted margin shall be punch dressed.

**Hammer Dressed Surface** - A hammer dressed stone shall have no sharp and irregular corners and shall have a comparatively even surface so as to fit well in masonry. Hammer dressed stone is also known as hammer faced, quarry faced and rustic faces. The bushing from the general wall face shall not be more than 40mm on exposed face and 10mm on faces to be plastered

**Rock Faced Surface** - A rock faced stone shall have a minimum of 25mm wide chisel drafted margin at the four edges, all the edges being in the same plane.

**Rough Tooled Surface** - A rough tooled surface shall have a series of bands, made by means of a plane chisel 4 to 5 cm wide, more or less parallel to tool marks all over the surface. These marks may be either horizontal, vertical or at an angle of 45° as directed. The edges and corners shall be square and true. The depth or gap between the surface and true. The depth or gap between the surface and straight edge, held against the surface shall not be more than 3mm (Rough tooled stones are used where fairly regular plane faces are required for masonry work).

**Punched Dressed Surface** - A rough surface is further dressed by means of punch chisel to show series of parallel ridges. The depth of gap between the surface and a straight edge held against the surface shall not exceed 3 mm. Punched dressed stones are used where even surfaces are required.

**Close Picked Surface** - A punched stone is further dressed by means of point chisel so as to obtain a finer surface, ridges or chisel marks left over being very tiny. The depth of gap between the surface and a straight edge kept over the surface shall not exceed 1.5 mm

**Fine Tooled Surface** - Close picked surface is further dressed so that all the projections are removed and fairly smooth surface is obtained. The surface shall have 3 to 4 lines per centimeter width depending on the degree of hardness of stone and degree of fineness required. This type of dressing is commonly adopted for ashlar work.

**Polished Surface** - Surface having a high gloss finish. Polishing of stones shall be done by robbing them with suitable abrasive, wetting the surface where necessary with water. Alternatively polishing of stones shall be done by holding them firmly on the top of revolving table to which some abrasive material like sand or carborundum is fed. The final polishing shall be performed by rubber or felt, using oxide of lime (Called by trade name as putty powder) as a polishing medium

**.Moulded** - Cut to profile of a moulding with punched dressed surfaces, unless otherwise specified

#### 6.2.4 Laying

The masonry work shall be laid to lines, levels, curves and shapes as shown in the plan. The height, in each course, shall be kept same and every stone shall be fine tooled on all beds, joints and face full and true. The exposed faces shall be gauged out, grooved, regulated and sunk or plain moulded as the case may be.

Stones shall be sufficiently wetted before laying to prevent absorption of water from mortar. Stratified stones must be laid on their natural beds. All bed joints shall be normal to the pressure upon them.

Stones in the hearting shall be laid on their broadest face that gives a better opportunity to fill the spaces between stones. The practice of placing loose mortar on the course and pouring water on it to fill the gaps in stones is not acceptable. Mortar may be fluid mixed thoroughly and then poured in the joints. No dry or hollow space shall be left anywhere in the masonry and each stone shall have all the embedded faces completed covered with mortar.

Shaping and dressing shall be done before the stone is laid in the work. No dressing and hammering, which will loosen the masonry, will be allowed after it is once placed. All necessary chases for joggles, dowels and clamps should be formed before hand.

Sufficient transverse bonds shall be provided by the use of bond stone extending from the front to the back of the wall and in case of thick wall from outside to the interior and vice versa. In the latter case, bond stones shall overlap each other in their arrangement. At least one band stone or a set of band stones shall be providing for every 0.5 sqm of the area of wall surface. All band stones shall be marked suitably with paint as directed by Engineer-in-Charge.

In case, headers are not available, precast headers of M 15 concrete shall be used. Cast-in-situ headers are not permitted.

Stones shall break joint on the face for at least half the height of the course and the bond shall be carefully maintained throughout.

In band work at all angle junctions of walls, the stones at each alternate course shall be carried into each of the respective walls so as to unite the work thoroughly.

The practice of building up thin faces tied with occasional through stones and filling up the middle with small stuff or even dry packing is not acceptable.

All quoins and the angles of the opening shall be made from selected stones, carefully squared and bedded and arranged to bond alternately long and short in both directions.

All vertical joints shall be truly vertical. Vertical joints shall be staggered as far as possible. Distance between the nearer vertical joints of upper layer and lower shall not be less than half the height of the course.

Only rectangular shaped bond stones or headers shall be used. Bond stones shall overlap each other by 150mm or more.

All connected masonry in a structure shall be carried up nearly at one uniform level throughout but when breaks are unavoidable, the masonry shall be raked in sufficiently long steps to facilitate jointing of old and new work. The stepping of raking shall not be more than 45 degree with the horizontal.

Quoin stone i.e. stone specially selected and neatly dressed for forming an external angle in masonry work, shall not be less than 0.03 cubic metre in volume.

The plum stones are selected long stones embedded vertically in the interior of the masonry to form a bond between successive courses and shall be provided at about 900mm. intervals.

### **6.2.5 Protection**

Green work shall be protected from rain by suitable covering. The work shall also be suitably protected from damage mortar dropping and rain during construction.

### **6.2.6 Curing**

Masonry work in cement mortar shall be kept constantly moist on all faces for a minimum period of seven days.

### **6.2.7 Measurements**

Height of one storey will be considered 4.0 metre. In case ceiling height is more than 4.0 metre in one floor, it will be treated as extra storey and payment for all items will be made accordingly.

#### **Stone Work:**

- a) The length, height and thickness shall be measured in metres with minimum unit of 1 cm. The quantity of volume and area shall be calculated in cum and sqm respectively correct to two places of decimal.
- b) The thickness of the wall shall be measured at the joints excluding bushing. Only specified dimensions shall be allowed anything extra shall be ignored.
- c) No deduction shall be made nor extra payment shall be made for the following.
  - i) Ends of dissimilar materials (that is joists, beams, lintels, posts, girders, rafters purlins, trusses, corbels, steps etc.) upto 0.1 sqm in section.

Opening each upto 0.1 sqm in area. In calculating the area of openings, any separate lintels or sill shall be included along with the size of opening but the end portions of the lintels shall be excluded and the extra width of rebated reveals, if any, shall also be excluded.

- ii) Wall plates and bed plates, and bearing of chajjas and the like, where the thickness does not exceed 10cm and the bearing does not extend over the full thickness of the wall.

**Note:** The bearing of floor and roof shall be deducted from wall masonry.

- iv) Drain holes and recesses for cement concrete blocks to embed hold fasts for doors, windows etc.
- v) Building in masonry, iron fixture, pipes upto 300mm dia, hold fasts of doors and windows etc.

- vi) Forming chases in masonry each upto section of 350 sqcm.
- d) Extra payment shall be allowed for stone work in square or rectangular or circular pillars or curved masonry over the rate of stone work in walls.

**Frame Work:**

The frame work for dry cladding shall be measured in linear basis in metres with minimum unit 1 cm and weight of frame work will be calculated by multiplying the length measured to actual average weight of steel section recorded.

**Clamps:**

The clamps shall be counted in number and the weight will be worked out by multiplying the quantity to average weight of clamps recorded.

**6.2.8 Rates**

The rate includes the cost of all materials, labour, machinery, tools required to execute the work including scaffolding, racking out of joints for plastering or pointing, preparing tops and sides of existing walls and curing etc. complete.

**6.3 Brick Work**

**6.3.1 General**

This work shall consist of construction of structures with bricks jointed together by cement mortar in accordance with the details shown on the drawings or as approved by the Engineer.

**6.3.2 Properties & Classification Of Bricks:**

**Burnt clay bricks:** Burnt clay bricks shall conform to the requirements of IS: 1077. Bricks shall be hand moulded or machine moulded. They shall be free from nodules of free lime, visible cracks, flaws warpage and organic mater. The bricks shall have smooth rectangular faces with sharp corners and emit a clear ringing sound. Bricks having compressive strength of 35 kg/sqcm shall only be used in load bearing structure.

**Fly Ash Lime Bricks:** Fly ash brick shall conform to the requirements of IS: 12894-2002. The bricks shall be sound, compact and uniform in shape and colour. The bricks shall be free from visible cracks, flaws, war page. Fly ash brick having compressive strength of 35 kg/sqcm shall only be used in load bearing structure.

**Classification:** Bricks tiles shall be classified on the basis of their minimum compressive strength as given below.

**Table 1**

Class Designation	Compressive strength			
	Not less than		Less than	
	N/mm <sup>2</sup>	(Kgf/cm <sup>2</sup> )	N/mm <sup>2</sup>	(Kgf/cm <sup>2</sup> )
100	10	(100)	12.5	125
75	7.5	(75)	10	100
50	5	(50)	7.5	75
40	4	(40)	5.0	50
35	3.5	(35)	4.0	40
25	2.5	(25)	3.0	30

20	2.0	(20)	2.5	25
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**Dimension:** The brick may be non-modular or modular. Sizes for both types of brick/tiles shall be as per Table 1 given below. Non-modular bricks/ tiles of sizes other than the size mentioned in Table 1 may also be used wherever standard size is not available.

**Table 2**

• Type of Bricks/ Tiles	Nominal Size mm	• Actual Size mm
Non-modular bricks	229x114x70mm	225x110x70mm
Non-modular tile bricks	229x114x44mm	225x110x30mm
Modular bricks	200x100x100mm	190x90x90mm
Modular tile bricks	200x100x40mm	190x90x40mm

### 6.3.3 Mortar

The mortar for the brick work shall be as specified, and as per details given in Chapter V of this SOR.

### 6.3.4 Soaking Of Bricks

Bricks shall be soaked in water before use for a period of minimum one hour prior to being laid. The bricks required for masonry work using mud mortar shall not be soaked. When the bricks are soaked they shall be removed from the tank sufficiently early so than at the time of laying they are skin-dry. Such soaked bricks shall be stacked on a clean place where they are not again spoiled by dirt earth etc.

### 6.3.5 Laying

Bricks shall be laid in English Bond unless otherwise specified. For brick work in half brick wall, bricks shall be laid in stretcher bond. Half or cut bricks shall not be used except as closer where necessary to complete the bond. Closers in such cases, shall be cut to the required size and used near the ends of the wall. Header bond shall be used preferably in all courses in curved plan for ensuring better alignment.

All loose materials, dirt and set lumps of mortar which may be lying over the surface on which brick work is to be freshly started, shall be removed with a wire brush and surface wetted.

Bricks shall be laid on a full bed of mortar. When laying, each brick shall, be properly bedded and set in position by gently pressing with the handle of a trowel, Its inside face shall be buttered with mortar before the next bricks is laid and pressed against it. Joints shall be fully filled and packed with mortar such that no hollow space are left inside the joints.

The thickness of the joints shall not be more than 10 mm in both the direction.

Bricks shall be laid with frog (where provided) up. However when top course is exposed, bricks shall be laid with frog down. For the bricks to be laid with frog down, the frog shall be filled with mortar before placing the brick in position.

In case of wall one brick thick and under, one face shall be kept even and in proper plane, while the other face may be slightly rough. In case of wall more than one brick thick, both the faces shall be kept even and in proper plane.

Brick work shall be done true to plumb or in specified batter. All courses shall be laid truly horizontal and vertical joints shall be truly vertical. Vertical joints in alternate courses shall come directly one over the other.

During construction, no part of work shall rise more than one metre above the general construction level, to avoid unequal settlement and improper jointing. Where this in not possible in the opinion of the Engineer, the works shall be raked back according to the bond (and not toothed) at an angle not steeper

than 45 degrees with prior approval of the Engineer. Tothing may also be permitted where future extension is contemplated. For half brick partition to be keyed into main walls, indents shall be left in the main walls.

The brick work shall be built in uniform layers and for this purpose wooden straight edge with graduations indicating thickness of each course including joint shall be used. Corners and other advanced work shall be raked back.

Where fresh masonry is to join with masonry that is partially/entirely set, the exposed jointing surface of the set masonry shall be cleaned, roughened and wetted, so as to effect the best possible bond with the new work. All loose bricks and mortar or other material shall be removed.

In the case of vertical or inclined joints, it shall be further ensured that proper bond between the old and new masonry is obtained by interlocking the bricks. Any portion of the brick work that has been completed shall remain undisturbed until thoroughly set.

Care shall be taken during construction that edges of jambs, sills and projections are not damaged in case of rain. New built work shall be covered with gunny bags or tarpaulin so as to prevent the mortar from being washed away. Damage, if any, shall be made good to the satisfaction the Engineer-in-Charge.

### **6.3.6 Scaffolding**

The Scaffolding used for execution shall be sound, strong and safe to withstand all dead, live and impact loads which are likely to come on them. Scaffolding shall be provided to allow easy approach to every part of the work. The holes which provide resting space for horizontal members shall not be left in masonry under one metre in width or immediately near the skew backs of arches. The holes left in the masonry work for supporting the scaffolding shall be filled and made good. Scaffolding shall be got approved by the Engineer-in-Charge. However, the Contractor shall be responsible for its safety.

### **6.3.7 PROTECTIONS & CURING**

Green work shall be protected from rain by suitable covering and shall be kept constantly moist on all faces for a minimum period of seven days. Bricks work carried out during the day shall be suitable marked indicating the date on which the work is done so as to keep a watch on the curing period. The top of the masonry work shall be left flooded with water at the close of the day. Watering may be done carefully so as not to disturb or wash out the green mortar.

During hot weather, all finished or partly completed work shall be covered or wetted in such a manner as will prevent rapid drying of the brickwork.

During the period of curing of brick work, it shall be suitable protected from all damages. At the close of day's work or for other period of cessation, watering and curing shall have to be maintained. Should the mortar perish i.e. become dry, white or powdery through neglect of curing, work shall be pulled down and rebuilt as directed by the Engineer. If any stains, appear during watering, the same shall be removed from the face.

### **6.3.7 Testing**

As per relevant IS code

### **6.3.8 Measurement**

- (a) Brick work shall be measured in cubic metre or square metre as specified in the item. Any extra work over the specified dimensions shall be ignored. Dimensions shall be measured correct to the nearest 0.01 m i.e. 1cm. Areas shall be calculated to the nearest 0.01 square metre and the volume shall be worked out to the nearest 0.01 cubic metre.
- (b) Brick work in parapet walls, mummy, lift machine room and water tanks constructed on the roof upto 1.2 m height above roof shall be measured together with the corresponding work of the floor next below.

- (c) No deductions or additions shall be done and no extra payment made for the following :
- (i) Ends of dissimilar materials (that is, joists, beams, lintels, posts, girders, rafters, purlins, trusses, corbels, steps, etc.); up to 0.1 m<sup>2</sup> in section.
  - (ii) Opening up to 0.1 m<sup>2</sup> in area at any point in area.
  - (iii) Wall plates, bed plates, and bearing of slabs, chajjas and the like, where thickness does not exceed 10 cm and bearing does not extend over the full thickness of wall.
  - (iv) Cement concrete blocks as for hold fasts and holding down bolts.
  - (v) Iron fixtures, such as wall ties, pipes upto 300 mm diameter and hold fasts for doors and windows.
  - (vi) Chases of section not exceeding 50 cm in girth.
  - (vii) Bearing portion of drip course, bearing of moulding and cornice.
- (d) Extra payment shall be allowed for brick work in square or rectangular pillars or circular pillars or curved masonry over the rate of brick work in walls

### **6.3.9 Rate**

The rate includes the cost of materials, labour, machinery, tools required to execute the work including scaffolding, racking out of joints for plastering or pointing, preparing tops and sides of existing walls and curing etc. complete.

## C.9 Wood Work

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### 9.1 Terminology

**Ballies** : Thin round poles usually without bark.

**Beam** : A structural timber generally long in proportion to its width and thickness and used for supporting load primarily by its internal resistance to bending.

**Block Board** : A Board having a core made up of strips of wood, each not exceeding 25 mm in width, laid separately or glued or otherwise joined to form a slab which is glued between two or more outer veneers with the direction of the grain of the core blocks running at right angles to that of the adjacent outer veneers.

**Core** : The inner layers of a composite wood product.

**Cross Band** : A general term indicating a transverse layer of veneer or veneers in composite wood products.

**Decorative Veneers** : Veneers having attractive appearance due to figure, colour, grain, lusture, etc.

**Hard Wood** : A conventional term used to denote the wood obtained from broad-leaved trees. It has no relationship to the physical properties of hardness or strength. On account of the confusion this word might cause, its use is discouraged.

**Freeze Rail** : Horizontal member, mortised or other-wise secured to the stiles of a door, provided just below the freeze panel usually provided for decora-tive purposes in the uppermost portion of the door.

**Joint** : A prepared connection for joining adjacent pieces of wood, veneer, etc.

**Dovetail Joint** : A joint at the corner of two pieces in such a way that the notches made to one are fitted exactly into projections of corresponding size and shape made in the other. There are various kinds of dovetail joints for instance, lapped dovetail joint, wedge shaped dovetail joint, etc. joined in a way which will resist withdrawal except in the direction in which it was assembled .

**Mitred Joint** : A joint, between two members at an angle which bisects the joining angle usually the joining faces are cut at 45° to form a right angle **Mortise and Tenon Joint** : A joint in which the redu-ced end (tenon) of one member fits into the corres-ponding slot (mortise) in another member .

**Tongue and Groove Joint** : A joint in which a tongue is provided on edge of one member to fit into a corresponding groove on the other.

**Knot** : Base of a branch or limb embedded in the tree which becomes visible when it is cut.

**Diameter of a Knot** : The maximum distance bet-ween two points farthest apart on the periphery of a round knot, on the face where it becomes visible. In the case of a spike or splay knot, the maximum width of the knot visible on the face on which it appears shall be taken as its diameter.

**Muntin** : Small horizontal or vertical dividing bars within basic framework of a window, or door sub-dividing and supporting the glass panes or panels of doors.

**Particle Board** : A board manufactured from particles of wood or other ligno-cellulose material, for example, flakes, granules, shavings, slivers, splinter agglomerated, formed and pressed together by use of an organic binder together with one or more of the agents, such as heat, pressure, moisture and a catalyst.

**Particle** : Distinct particle or fraction of wood, or other lignocellulose material produced mechanically for use as the aggregate for making a particle board. This may be in the form of flake, granule, shaving, splinter and sliver.



**Plywood** : A board formed of three or more layers of veneers cemented or glued together, usually with the grain of adjacent veneers running at right angles to each other.

**Rebate** : A recess along the edge of a piece of timber to receive another piece or a door, sash or a frame.

**Sapwood** : The outer layers of the log, which in the growing tree contain living cells and feed material.

The sapwood is usually lighter in colour, and is readily attacked by insects and fungi.

**Seasoning** : A process involving the reduction of moisture content in timber under more or less controlled conditions towards or to an amount suitable for the purpose for which it is to be used.

**Seasoned Timber** : Timber whose moisture content has been reduced to the specified minimum, under more or less controlled processes of drying.

**Structural Timber** : Timber used in framing and load bearing structures or timber used or intended for use in buildings where strength is the primary consideration.

## 9.2 Materials

The materials to be used should be as specified in items and shall have the following properties:

- i) **Timber:** The timber shall be free from decay, fungal growth, boxed heart, pitch pockets or streaks on the exposed edges, splits and cracks. The timber shall be of best quality. The knots should be avoided over a specified limit.
- ii) **Plywood Boards:** Plywood boards are formed by gluing and pressing three or more layers of veneers with the grains of adjacent veneers running at right angles to each other. The veneers shall be either rotary cut or sliced and shall be sufficiently smooth to permit an even spread of glue. Face veneers may be either commercial or decorative on both sides or one side commercial and the other decorative. Plywood shall be of BWP grade or BWR grade as per IS: 303.
- iii) **Particle Boards:** Particle boards shall be of medium density and manufactured from particles of agro waste, wood or lignocellulose i.e. material blended with adhesive and formed into solid panels under the influence of heat, moisture, pressure etc. The particle boards shall be flat pressed with single, three or multi layers and graded and of Type I as per Table 1 of IS: 3087. Both surfaces of the boards shall be sanded to obtain a smooth finish.
- iv) **Veneered Particle Boards:** Veneered Particle Boards have a solid core of medium density Type I particle board which is covered with commercial or decorative veneers on both faces or with decorative veneers on one face and commercial veneers on the other. Face veneers are bonded using adhesives under the influence of heat and pressure. Veneered particle board shall be of exterior grade (Grade I) as per IS : 3097. Both surfaces of the boards shall be sanded to a smooth finish.
- v) **Hard Board:** Hard boards are generally classified into the following three types according to their method of manufacture, density and other related mechanical and physical properties.
  - (a) Medium hard board : A homogenous fibre building board having a density exceeding  $480 \text{ kg/m}^3$  but not exceeding  $800 \text{ kg/m}^3$ .
  - (b) Normal hard board : A homogenous fibre building board having a density exceeding  $800 \text{ kg/m}^3$  but not exceeding  $1200 \text{ kg/m}^3$ .
  - (c) Tempered hard board : Hard board which has been further treated in the course of manufacture to increase its density, strength and water resistance.
- vi) **Block Board:** Block Boards have a solid core made up of uniform strips of wood each not exceeding 25 mm in width, laid separately, or spot glued, or otherwise joined to form a slab which is glued. Between two or more outer veneers, with the direction of the grain of the core block running at right

angles to that of adjacent veneers. In any one block board, the core strips shall be of one species of timber only. Face veneers may be decorative or commercial on both faces or decorative on one face and commercial on the other. Block boards shall be Grade I (Exterior Grade) as per IS : 1659. Both surfaces of the boards shall be sanded to a smooth finish.

- vii) Asbestos Cement Board:** This should conform to IS : 2096-1966. The material used in the manufacture of asbestos cement building boards shall be composed of an inert aggregate consisting of clean asbestos fibre cemented together by ordinary portland cement, rapid hardening and low heat portland cement, or blast furnace slag cement. No organic or inorganic materials shall be added to the composition. Pigments which are embodied in the asbestos cement for colouring purpose shall be of permanent colours and shall conform to the requirements. The thickness of the asbestos cement board used for panelling shall not generally be less than 6.5 mm in case of single panels shutters and 5 mm in case of two or more panel shutter. Asbestos cement building boards shall be of two classes, namely class 'A' and class B. The thickness of class A shall be 6.5 mm and for class 'B' 5 mm. The tolerance on thickness shall be  $\pm 0.5$  mm.
- viii) Fibre Boards:** Fibre boards shall be of medium density and manufactured from wood fibre, produced by fiberizing steamed wood under pressure, blended with adhesive and wax and formed into solid panels under controlled conditions of heat and pressure. Fibre boards are flat pressed single layer and shall be Exterior Grade as per IS : 12406. Both surfaces of the boards shall be sanded to a smooth finish.
- ix) Adhesive:** Adhesive used for bonding BWP grade of plywood boards shall be BWP type synthetic resins conforming to IS : 848 respectively.
- x) Sheet Glass:** Sheet Glass shall be flat, transparent and clear as judged by the unaided eye. It may, however, possess a slight tint when viewed edgewise. Sheet glass shall be of selected Quality (SQ) or Ordinary Quality (OQ) as per IS : 2835. Glass shall be free from cracks. Unless otherwise specified, ordinary quality sheet glass shall be used.
- xi) Wire Cloth (Wire Gauze):** Wire Cloth which shall generally conform to IS : 1568-1970 shall be regularly woven with equally spaced galvanised mild steel wires in both warp and weft directions. The wire cloth shall be properly selvaged by one or more wires in each edge.
- xii) Gypsum Board:** Gypsum Board is formed by enclosing and bonding together a core gypsum plaster (a calcium sulphate mineral) with or without fibre between two sheets of highly durable paper. The gypsum boards shall be non-resonant, dimensionally stable and possesses flame retardant qualities. The boards shall conform to IS : 2095-1976 and gypsum plaster shall conform to IS : 2547-1976. The surfaces of the board shall be true and free from imperfection that would render the board unfit for use with or without decoration.
- xiii) Fittings:** All fittings and fixtures like hinges, aldrops, tower bolts, handles, nails, screws etc. shall be as per relevant IS specifications and of specified material as per item.

### 9.3 Fabrication

**Frames:** Timber for door, window and ventilators frames shall be as specified. Timber shall be sawn in the direction of the grains. All members of a frame shall be of the same species of timber and shall be straight without any warp or bow. Frames shall have smooth, well-planed (wrought) surfaces except the surfaces touching the walls, lincels, sill etc., which may be left clean sawn. Rebates, rounding or moulding shall be done before the members are jointed into frames. The depth of the rebate for housing the shut-ters shall be 15 mm, and the width of the rebates shall be equal to the thickness of the shutters. A tolerance of  $\pm 3$  mm and 2 mm shall be permitted in the speci-fied finished dimensions of timber sections in frames.

**Trusses:** As per drawing, a full size truss diagram shall first be drawn on a levelled platform. From this full size diagram, templates of all joints as for tenons, mortises, scarves etc. shall be made for use in the

fabrication. The template shall be made to correspond to each member and plate holes for screws and bolts shall be marked accurately on them and drilled. The templates shall be laid on wooden members and the holes for screwing and bolting marked on them. The ends of the wooden members shall also be marked for cutting. The base of columns and the position of anchor bolts shall be carefully set out. Before fabrication of the truss individual members shall be assembled together to ensure close abutting or lapping of the surfaces of the different members and fitted close together as per drawing.

**Frame Work:** Timber for stiles and rails shall be of the same species and shall be sawn in the directions of grains. Sawing shall be truly straight and square. The timber shall be planed smooth and accurate to the required dimensions. The stiles and rails shall be joined to each other by plain or haunched mortise and tenon joints and the rails shall be inserted 25 mm short of the width of the stiles. The bottom rails shall have double tenon joints and for other rails single tenon joints shall be provided. The lock rails of door shutter shall have its centre line at a height of 800 mm from the bottom of the shutters unless otherwise specified. The thickness of each tenon shall be approximately one-third the finished thickness of the members and the width of each tenon shall not exceed three times its thickness.

**Panelling:** The panel inserts shall be either framed into the grooves or housed in the rebate of stiles and rails. Timber, plywood, hard board and particle board panels shall be fixed only with grooves. The depth of the groove shall be 12 mm and its width shall accommodate the panel inserts such that the faces are closely fitted to the sides of the groove. Panel inserts shall be framed into the grooves of stiles and rails to the full depth of the groove leaving on space of 1.5 mm. Width and depth of the rebate shall be equal to half the thickness of stiles and rails. Glass panels, asbestos panels wire gauze panels and panel inserts of cupboard shutters shall be housed in the rebates of stiles and rails.

**Flush door shutters:** Flush door shutters shall have a solid core and may be of the decorative or non-decorative (Paintable type as per IS : 2202 (Part I). Nominal thickness of shutters may be 25, 30 or 35 mm. Thickness and type of shutters shall be as specified.

**Louvered shutters:** Specified timber shall be used, and it shall be sawn in the direction of the grains. Sawing shall be truly straight and square. The timber shall be planed smooth and accurate to the full dimensions, rebates, roundings and moulding as shown in the drawings made, before assembly. Patching or plugging of any kind shall not be permitted except as provided. Width and height of the shutters shall be as shown in the drawings or as indicated by the Engineer-in-Charge. All four edges of the shutters shall be square. The shutter shall be free from twist or warp in its plane. The moisture content in timbers used in the manufacture of flush door shutters shall be not more than 12 percent when tested according to IS: 1708-1986.

## 9.4 Joints

Joints shall be simple, neat and strong. All mortise and tenon joints, mitred joints, scarfs etc. shall fit in fully and accurately without wedging or fillings. The joints shall be as per detailed drawings. Holes of correct sizes shall be drilled before inserting screws/bolts. Driving in screws with hammer is prohibited. Holes for bolts shall be of uniform diameter. The screws, bolts and nails shall be dipped in oil before using. The heads of nails and screws shall be sunk and puttied or dealt with as instructed by Engineer-in-Charge. The gauge and Length of nails, screws and bolts shall be approved by the Engineer-in-Charge before using on works. The contact surfaces of all type of joints shall be treated, before putting together, with bulk type synthetic resin adhesive conforming to IS: 851-1978 suitable for construction in wood or synthetic resin adhesive (Phenolic and aminoplastic) to IS: 848- 1974 or polyvinyl acetate dispersion based adhesive conforming to IS: 4835-1979 and pinned with 10 mm hard wood dowels or bamboopins or star shaped metal pins, after the frames are put together & pressed in position by means of press.

## 9.5 Measurements

All types of wood work shall measured for finished dimension without allowance for the wastage. However, in case of members having mouldings, roundings or rebates and members of circular or varying

section, finished dimensions shall be taken as the sides of the smallest square or rectangle from which such a section can be cut.

The length and breadth shall be measured correct to centimeter and thickness shall be measured correct to millimeter, where the unit of measurement is cubic meter. The quantity shall be calculated in cubic meter correct to two places of decimal.

The length and breadth shall be measured correct to centimeter where the unit of measurement is square meter. The quantity shall be calculated in square meter correct to two places of decimal.

The length shall be measured correct to centimeter where the unit of measurement is running meter

The length shall be measured correct to centimeter and the quantity shall be calculated by multiplying the actual weight of the section where the unit of measurement is kg.

The all type of fittings shall be counted in number where the unit of measurement is each.

## **9.6 Rate**

The rate of wood work includes cost of all material, labour, hardware, T&P, wastages and hire & running charges of machinery etc. and also includes cost of erecting & fixing in position at all levels, leads and lifts.

## C.7 Steel And Aluminium Work

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### 7.1 Materials

All finished steel shall be well and cleanly rolled to the dimensions and weight specified by BIS subject to permissible tolerances as per IS 1852-1985. The finished materials shall be reasonably free from cracks, surface flaws laminations, rough and imperfect edges and all other harmful defects. The materials used in steel and aluminium work shall be as follows:

- i) Structural steel shall be of tested, standard quality conforming to IS: 226:1975 commercial quality shall conform to IS: 269:1969.
- ii) Steel work in single section are for works, like hold fasts & iron work for wooden trusses, M.S. Square/round guard bars fixed in wooden or steel windows & ventilators frames etc.
- iii) Steel work riveted or bolted shall conform to IS: 1148-1968 and IS: 800-1962.
- iv) Welding of steel shall be electric arc welding as per IS: 816-1969 and shall be on the lines given in IS 800-1984. The electrodes required for metal arc welding shall conform to IS: 814-1991
- v) Rolling shutters should conform to IS: 6248-1979.
- vi) Rolled steel sections for fabrication of steel glazed doors, windows & ventilators shall conform to IS: 7452-1974.
- vii) Glass panes should conform to IS: 7452-1974.
- viii) Screws shall conform to IS: 4218 (Part I to VI) 1967.
- ix) Steel doors, windows & ventilators shall conform to IS: 1038-1983 and IS: 7452-1990.
- x) Cold rolled framed profiles of pressed steel made from commercial M.S. sheets conforming IS:513 of 1973 and as per general specifications of IS: 4351 are to be filled with M-15 grade of concrete and rates of items with these section are inclusive of the cost of concrete.
- xi) Structural steel tube shall conform to the IS:1161-1979. The steel tubes when analyzed in accordance with the method specified in IS: 226-1975 shall show not more than 0.06 percent sulphur, and not more than 0.006 percent phosphorus. Wall thickness of tubes used for construction exposed to weather shall be not less than 4 mm and for construction not exposed to weather it shall be not less than 3.2 mm. Where structures are not readily accessible for maintenance, the minimum thickness shall be 5 mm.
- xii) Aluminium sections used for making doors, windows & ventilators shall conform to IS: 733-1983 and IS: 1285-1975. Aluminium sections used shall be anodised, transparent or dyed to the required shade and should conform to IS: 1868 (minimum anodic coating of grade AC-15). Hydraulic floor spring to be used shall conform to IS: 6315.
- xiii) Pre-laminated particle board shall conform to IS: 12823-1990.

### 7.2 Fabrication

Fabrication shall generally be done as specified in IS: 800-1984. The steel sections as specified shall be straightened and cut square to correct lengths and measured with a steel tape. The cut ends exposed to view shall be finished smooth. No two pieces shall be welded or otherwise joined to make up the required length of a member.

Welding shall be done by electric arc process as per IS: 816-1969 and 823-1964. The electric arc method is usually adopted and is economical. Where electricity for public is not available generators shall be arranged by the contractor at his own cost unless otherwise specified. Gas welding shall only be resorted

to using oxyacetylene flame with specific approval of the engineer-in-charge. Gas welding shall not be permitted for structural steel work.

Aluminium Frames shall be square and flat, both the fixed and openable frames shall be constructed of sections, which have been cut to length, mitred and mechanically jointed at the corners. Sub-dividing bar of units shall be tenoned and riveted into frames. All frames shall have corners welded to true right angles. For jointing hollow sections flash butt welding, argon arc welding or mechanically jointing by inserts shall be used. (Gas welding shall not be done). Concealed screws shall be used for jointing the sub-units. The aluminium doors shall be manufactured by reducing, the specified size shown in drawing, by 12.5 mm in height and 25 mm in sides, however the windows size will be reduced by 25 mm in height as well as insides.

### **7.3 Surfacing**

All surfaces which are to be painted, oiled or otherwise treated shall be dry and thoroughly cleaned to remove all loose scale and loose rust. Surfaces not in contact but inaccessible after shop assembly, shall receive the full specified protective treatment before assembly. This does not apply to the interior of sealed hollow sections. Part to be encased in concrete shall not be painted or oiled. A priming coat of approved steel primer i.e Red Oxide Zinc chrome primer conforming to IS:2074-1979 shall be applied before any member of steel structure are placed in position or taken out of workshop.

The surfaces which are to be powder coated shall be thoroughly cleaned to remove all loose rust & scale. The powder coating of specified thickness shall be applied before any member of steel structure are placed in position or taken out of workshop.

### **7.4 Erection**

Steel work shall be hoisted and placed in position carefully without any damage to itself and other building work and injury to workmen. Where necessary mechanical appliances such as lifting tackle winch etc. shall be used. The suitability and capacity of all plant and equipment used for erection shall be to the satisfaction of the Engineer-in-Charge.

### **7.5 Testing**

The steel will be tested for Tensile Strength and Bend Test as per IS:1599-1974 for the quantity 20 Tonne and at every 20 Tonne or part thereof.

### **7.6 Measurements**

The steel sections as fixed in place shall be measured in running metre correct to a millimetre and weights calculated on the basis of standard tables correct to the nearest kilogram, where unit of payment is in kilogram, however where the actual weight of section used is less than standard weight than the weight shall be calculated on the basis of actual weight. The length of T/angle iron frame shall be measured along the center line of the frame.

The length shall be measured in running metre correct to a centimeter along the center line of the frames, where unit of measurement is running metre.

The height and breadth shall be measured correct to a cm. The area shall be calculated in sqm upto two places of decimal where the unit of measurement is sqm.

The length of each extruded aluminium section used for fabrication shall be measured correct to 1 mm and the weight of material used shall be calculated on the basis of actual weight of extruded section used for fabrication upto two places of decimal. The inserts/angle clips used for joining the section will not be measured.

## 7.7 Rates

The rate of steel work includes cost of all material, labour, hardware, T&P, wastages and hire & running charges of machinery etc. and also includes cost of all fixtures, erecting & fixing position including priming coat.

The rate of aluminium doors, windows & ventilator includes cost of all material, labour, hardware, T&P, wastages and hire & running charges of machinery etc. and also includes cost of all fixtures, erecting & fixing position.

## 7.8 Indian Standards

IS 2062: 1999 – Steel for General Structural Purposes (specifications) ; including amendments in June 2001.

IS 9595: 1996 – Metal Arc welding of carbon and carbon Manganese Steels

IS 808: 1989 (reaffirmed 1999) – Dimensions for Hot Rolled Steel beam, channel, angle sections

IS 800: 1984 (reaffirmed 1998) – Code for practice for general construction in steel

Providing, erecting and fixing in position structural hollow steel sections of Yst 310 grade of TATA or equivalent conforming to IS:4923 purlins, roof trusses, columns, side runners, ties bracing, including all types of base plate, gusset plate, cap plate, bearing plate, stiffness, cleats etc. complete and structural steel conforming to IS:226 including necessary rolled joists, channels, angles, tees, flats, angle cleats, gusset plates, including cutting, welding as per the structural details and good engineering practice grinding and cleaning the members as per detailed drawing and design. The rate shall include for applying three coats of approved make synthetic enamel paint over a coat of zinc chromate anticorrosive paint, as per instructions by the consultant/site engineer and shown as per drawing. (Only finished measurements will be paid for). No extra payment shall be made for grouting that has to be done under the base plates to get full bearing on the supporting sub strata

All steel work shall conform to IS : 800-1984 (reaffirmed 1998) or latest edition and shall be free from defects impairing strength, durability or appearance and shall be of the best quality for the purpose specified, and possessing structural properties to withstand safely stresses to which these shall be normally subjected. The contractor shall bear the costs of the tests.

All structural steel members brought by the contractor shall be handled with care, stacked on edge and supported evenly.

The structural steel and rivet bars shall conform to latest edition of IS: 226. Before any fabrication work is commenced all plaster shall be flattened and all bars and sections are straightened or otherwise trued and made free from twist or other distortion. Method adopted for the purpose shall be such as not to injure the material. Cutting shall be the responsibility of the contractor. The contractor will have to submit shop drawings to the Architect/ Consultant. All shop drawing shall be prepared in advance of the drawing actual fabrication. These shall show full size sections and all joints and connections, thickness of materials used and details of welds, bolts, rivets etc. Shop drawings shall clearly distinguish between, shop and field rivets, bolts and welds. Drawing shall be made in conformity with the IS: code for shop drawings and with due regard to speed and economy in fabrication and erection. A making diagram allotting distinct identification marks to each separate piece of steel shall be prepared. The diagram shall be sufficient to ensure convenient assembly and erection at site. All shop drawings shall show temporary bracing and connections required fabrication and erection.

## 7.9 Riveting

All holes in platers or section over 12 mm thick must be drilled and not punched and accurately gauged. All holes (except in purlins, runners, packing plates, lacing bars) shall be drilled to required size. All

matching holes for rivets or black bolts shall be such that a gauge 0.8 mm less in diameter than the hole can pass freely through members assembled for riveting and bolting. All holes for turned and fitted bolts shall be drilled and reamed, if necessary, to tolerance of only plus 0.13 mm when the number of thickness to be riveted exceeds three or the total thickness is 90 mm. or more the holes shall be drilled or reamed in position after assembly, except when the steel bushed jigs are used. Parts shall be firmly held together during such block drilling and taken apart for removal of burrs, after drilling.

All parts assembled for riveting shall be in close contact and all bearing stiffeners shall bear tightly at both top and bottom without being drawn or caulked. All parts of riveted members shall be temporarily pinned or bolted while riveting. Drifting of holes shall not be permitted except to draw the part together and no drift used shall be larger in any part than the normal diameter of rivet or bolt. Drifting done during assembling shall not distort metal or enlarge hole. Rivets when cold shall be size shown on drawing and shall preferably fill the hole and from the head of standard dimension unless otherwise stated. All riveting wherever practicable shall be done by the hydraulic or pneumatic process. All loose, burnt or badly formed rivets with eccentric or deficient heads shall be cut and replaced by sound rivets. Counter sunk heads shall be provided wherever required. Caulking and recupping shall not be permitted.

## **7.10 Bolting**

All turned and fitted bolts shall be parallel throughout the barrel within the tolerance of only minus 0.13 mm and faces of heads and nuts bearing on steel work shall be machined. All such bolts shall be provided with washers of standard size so that the nut when turned shall not bear on the unthreaded body of the bolt. Heads and nuts shall be hexagonal with smooth surfaces and shall be well formed. Where the full bearing area of the rivet is to be developed, the threaded portion of the bolt shall not be within the thickness of the parts bolted together. Threaded portion of each bolt shall project beyond the nut at least by one thread. Tapered washers shall be provided for all heads and nuts bearing on beveled surfaces.

## **7.11 Welding**

Welding wherever indicated shall conform to latest edition of IS: 814-1963 unless otherwise specified. Welding shall be carried out by experienced welders only, who if necessary, shall produce testimonials about their work or if required by Architect/Consultant shall have to undergo qualifying tests as prescribed in latest edition of IS: 1181. Welding work shall be carried out as per latest edition of IS: 818.

Welding shall be done in flat position wherever possible and adequate steps shall be taken to maintain the correct arc length, rate of travel, current and polarity for the type of electrode and nature of work.

Steel shall not be painted or oiled and any areas where welding is to be performed shall be well cleaned to remove any paint, scale or rust immediately before welding for a distance of at least 2 cm (3/4") on either side.

The work shall be securely held in position by means of tack welds, service bolts, clamps or jigs before commencing the welding so as to prevent any relative movement due to distortion, wind or other causes. When welding is liable to cause distortion, the work shall be securely held in approved frames or jigs.

Parts to be filler welded shall be brought in as close contact as practicable and in no event shall be separated more than 4.75 mm (3/16"). If the separation is 1.6 mm (1/16"), or greater, the size of the fillet welds shall be increased by the amount of the separation.

The separation between facing surfaces of lap joints shall not exceed 1.6 mm (1/16"). The fit of joints at contact surfaces which are not completely sealed by welds, shall be close enough to exclude water after painting.

Abutting parts to be butt welded shall be carefully aligned. Misalignment greater than 3 mm (1/8") shall be corrected and in making the correction, the parts shall not be drawn a sharper slope than two degrees (11mm in 30 cm or 7/16" in 12").



The sequence of welding shall be such that when possible the members which offer the greatest resistance to compression are welded first. Welded joints showing slag inclusion or lack of proper penetration shall be cut and rewelded overlap of the toe of the weld and undercutting of the parent metal should be avoided and where present to a serious extent shall be rectified.

All slag shall be removed from each run before another run is superimposed. When cold the final run shall be protected with clean boiled linseed oil and shall not be painted until approved by the Architect/Consultant or his representative. Grinding of finished weld is permitted provided the weld is not reduced below the prescribed section. All exposed welds shall be ground smooth. Welds which have not been ground shall be scrubbed with a 10% solution of Hydrochloric acid which shall be washed off with before paint is applied an alkali resisting paint is used.

Other IS codes:

IS 812: 1957 (revised 1998)

IS 817 (Part 1 & 2) – Training of Welders – code of practice

## **7.12 Fabrication And Erection**

In order to facilities handling, transportation and execution contractor may fabricate structural members in suitable sections. The details of site connection and their location shall be approved by the Architect/Consultant. Frame or lattice section intended for use as parts of composite construction which are likely deflect considerably during handling shall be suitably stiffened by means of steel angles.

Roof and other structure shall be supported at close intervals during the welding/bolting or site connections. The frame of steel skeleton building shall be carried up true and plumb and temporary bracings shall be introduced wherever necessary to take care of all loads to which structures may be subjected including erection equipment and operation of the same, such bracing shall be kept in position as long as required for safety or as deemed necessary by the Architect/Consultant.

As erection progresses, the work shall be securely bolted to take care of all dead load, wind load and erection stresses. No riveting or welding shall be done until the structure has been properly aligned. Rivets driven in field shall be heated and driven with the same care as those driven in the shop.

In the setting or erection of steel work the individual pieces shall be considered plumb or level when error does not exceed 1 to 500. For exterior columns the error shall not exceed 1 to 1000.

Slight bends in the members of fabricated structure shall not be straightened unless strictly necessary on account of danger of overstraining connection and rivets, weld or bolts. Connection plates, if slightly bent or twisted shall be straightened cold. If bent so sharply as to require heating the whole piece thus heated shall be subsequently annealed. No straightening whatsoever shall be carried out without the previous sanctions of the Architect / Consultant / Engineer in charge. The contractor shall be fully responsible to match all profiles of the trusses as per the designs and shall if need be get all the sections precisely bent in precise bending equipments at factory level under proper supervision prior to erection on site.

## **7.13 Expansion Gaps**

Particular care must be taken to ensure free expansion and contraction, whatever provide for, drawing or special specification.

## **7.14 Painting**

Painting of steel structure shall be carried out as per detailed specification under painting.

### **7.14.1 Painting Joints**

The surface of all joints must be thoroughly scrapped cleaned and given the first coat of red lead paint before joining up which should be done while the paint is still wet. The procedure shall not apply to

welded joints. All rivets, bolts, washers, etc shall be thoroughly cleaned and dipped in boiled linseed oil. All machined surfaces shall be well coated with a mixture of white lead and tallow.

## **7.15 Measurements**

All fabricated trusses, frames, gantry girders, crane rails, fishplates, and clamps, square or round bars etc. Stanchions built girders and purlins shall be calculated on the basis standard net weight according to I.S.I. code. Net weight of clean, brackets, packing pieces, rivets, bolts distance pieces, separators, gussets holding down bolts, fish plates etc shall be added to the respective items. No deduction shall be made for holes, bolts or rivets and waste involved in cutting or nothing ends of sections or intermediate points for making connections. Weights for the bolts and nuts shall be measured but the weight of the weld shall not be considered. The rates shall be inclusive of all plants and heavy machinery required for its erection like cranes, temporary structures, concrete blocks, pulleys, hydraulic jacks etc.

## **7.16 Glass Works**

### **7.16.1 Applicable Indian Standards**

Work under this contract shall be carried out to following Indian or International standards. Any conflict noticed in various standards and building regulations shall be reported to the CONSULTANT and his direction and approval to be obtained. However it shall be noted as general rule that the more stringent specification shall apply. All standards shall be the latest revisions.

- 1) ASTM C 1046 Standard specification for Heat treated flat glass FT & HS coated and
- 2) Uncoated glass.
- 3) IS 3548 Glazing in building
- 4) CP 152 Glazing and fixing of glass for Building.

### **7.16.2 Quality Assurance**

- 1) Glass of each type to be produced by same manufacturer
- 2) Registered professional engineer licensed to practice structural engineering, with minimum of five years experience in design of glass and glazing shall be employed.
- 3) Installer shall be acceptable to manufacturer and with experience on at least five projects of similar nature in past five years.
- 4) Fabricated glass to comply with ASTM C1036, ASTM C1048, and ANSI Z97.I
- 5) Acoustic requirement shall be measured by decibel meter.
- 6) Heat transfer coefficient shall be tested in accordance with BS5713/ASTM E 774 as specified.
- 7) Submit following certificates
- 8) Manufacturer's letter certifying glass and glazing materials compatibility
- 9) Manufacturer's letter certifying that sealed insulating glass units meet or exceed specifications.
- 10) Engineering certifications

### **7.16.3 Submittals**

Submit for each type of glass and glazing material specified, including glazing accessories and glazing sealants.

#### **7.16.4 Shop Drawings**

The contractor shall prepare or obtain shop drawings from reputed sliding glass door system manufacturers and submit the same for approval along with samples of fixtures and sliding mechanism if asked for. Manuals of manufacturer's shall be strictly followed.

#### **7.16.5 Delivery, Storage And Handling**

Deliver, store and handle products in accordance with following:

Deliver glass units with manufacturer's labels intact on interior side of glass. Ensure labels

Indicate glass thickness, unit location, glass strength and orientation of units in vertical position.

Protect glass edges and corners against chipping and cracking.

All the fixtures and accessories related with the glass sliding door mechanism shall be delivered and kept in sealed packets and shall be opened just before installations so as to protect them from any kind of damage.

#### **7.16.6 Warranty**

Contractor shall provide warranty for the sliding glass doors against defects in glass and problems related with the sliding mechanism, motors, belts etc.

#### **7.16.7 Material**

##### **Glass**

All glass shall be Indian clear float glass as manufactured by M/s Float Glass India Ltd. (FGL) joint venture of Asahi Glass Co. Ltd. Japan or equivalent approved. Glass shall conform to IS 3548 – glass for glazing and recommendations therein.

##### **Toughened Glass Or Tempered Glass**

Tempered glass is an extremely strong glass which is heat treated to a uniform temperature of approximately 650deg C and rapidly cooled to induce compressive stresses of 770kg/sq m to 1462kg/sq m on the surfaces and edge compression of the order of 680kg/sq m. Any attempt to cut, drill, grind or sand blast after toughening may result in breakage and hence all holes etc as required shall be drilled prior to toughening the glass. No other glass but tempered glass shall be used for sliding doors, ticket counters and cutout coverings. The thickness of the glass shall be as per the drawings of the design consultants or as per the calculations of the manufacturer.

##### **Properties of Tempered Glass / Toughened Glass**

1. Density (approximate): 2.42-2.52 g/cubic cm
2. Tensile Strength: 120 to 200 N/sq .mm
3. Compressive Strength: 1000 N/sq.mm
4. Modulus of Elasticity: 70Gpa-
5. Coefficient of linear expansion:  $9 \times 10^{-6}$  m/Mk
6. U Value: 5.7 W/sq.m.K for 6mm thick clear
- 7 SF for 6 mm clear: 81 %
- 8 Shading coefficient of 6 mm clear: .93
- 9 Visible light transmission of 6 mm clear: 87 %

Thickness – 3mm to 19mm

### **Laminated Glass**

Laminated glass is a sandwich made of one piece of plastic Poly Vinyl Butyral (PVB) between two or more glasses. The PVB sticks with the glass, forms chemical as well as mechanical bonds. When laminated with annealed glass, the layer maintains the geometric integrity of the pane in case of breakage. Also it gives acoustic insulation as well as gives protection against damage caused due to UV radiation because it cuts almost 99% of UV radiation present in the sunlight. A Laminated glass is regarded as a safety glass by most of the standards. The glasses used for the purpose of making a laminated glass can be either float glass or toughened glass or as directed.

The Glass if otherwise specifically mentioned in the Bills of Quantities or design drawings shall be 4mm clear glass + 1.52PVB + 4mm clear glass of AIS, Saint Gobain, Asahi, ModiGuard or equivalent.

The framing around the glass shall be as per the designs and specifications.

### **Properties Of Laminated Glass**

- 1) PVB thickness --0.38mm, 0.76mm, 1.14mm, 1.52mm
- 2) PVB colors --Clear, white, gray, purple, blue, green, yellow, orange, red
- 3) Refractive Index -- 1.48
- 4) Visible Light Transmittance, Clear -- 89%
- 5) Shading Coefficient, Clear -- 0.92
- 6) UV Screening, up to 380 nm -- 99%
- 7) Tensile Strength -- 3220 psi
- 8) Tensile Elongation -- 205% (JIS K6771)
- 9) Specific Gravity -- 1.07
- 10) Specific Heat -- 0.47 Btu/lb°F
- 11) Thermal Conductivity (K value) -- 0.12 Btu/(ft<sup>2</sup>hr°F)
- 12) Coefficient of Thermal Expansion --  $2.6 \times 10^{-4}$  in./in.°F
- 13) Emissivity -- 0.9

### **Sealants**

General: Provide products of type indicated, complying with the following requirements:

Select glazing sealants that are compatible with one another and with other materials they will

contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

### **Gasket**

Neoprene extrusions in shape and sizes indicated, fabricated into frames with moulded corners.

These shall be of Neoprene, EPDM, Silicone, Thermoplastic polyolefin rubber or as approved.

## **7.16.8 Scope Of Work**

Work under this section shall be inclusive of design, fabrication and installation of toughened glass for sliding doors, ticket counters, signage etc as specified and as per the designs of the consultant including supply and installation of patch fittings of approved make as mentioned in the design drawings of the Consultant.

## **7.16.9 Workmanship**

Examine conditions and proceed with work when framing systems are ready for glazing.

- 1) Verify that openings for glazing, Sliding door/Window/ opening/ ticket counter work etc are correctly sized and within tolerances.
- 2) Verify that glazing channel surfaces or recesses are clear, free of burrs, obstructions,

Irregularities and glass is free of edge damage or imperfections.

#### **7.16.10 Preparation**

- 1) Clean contact surfaces with solvent and wipe dry.
- 2) Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- 3) Prime surfaces scheduled to receive sealant, if required by sealant manufacturer.
- 4) Verify that materials used for cleaning edges of sealed insulating units are compatible with sealants and components and will not damage or cause deterioration of integrity of sealed insulating unit.

\* Glass shall have safety marking as approved by the CONSULTANT at eye level.

\* Installation completed shall be sound, watertight, and free from defects and to acceptable standard of CONSULTANT.

#### **7.16.11 Tempered Glass**

Do not cut, seam, nip or abrade tempered glass.

The contractor shall ensure that the glass is firmly fixed in desired positions and the framing, SS studs, channels are also firmly fixed to the base surface. The edges shall be protected using a protective taping for all exposed edges of the glass during the execution of works. Holes shall be correctly made prior to toughening the clear glass. The contractor shall ensure that the holes for accommodating SS patch fittings, SS studs, screws, Aluminum framing members etc shall be marked precisely on the glass and alignments are matched before making the holes in glass.

All free intersecting edges of glass to glass, glass to wood, glass to aluminum framing, glass to stone etc shall be sealed properly using a good quality approved make structural silicone sealant. The rates of the contractor shall be inclusive of the sealants.

#### **7.16.12 Protection**

A. Protect finished work.

B. After installation, mark glass pane with X by using removable plastic tape or paste.

#### **7.16.13 Cleaning**

The PVC tape, protective covering shall be retained till the glass work is completed and until the CONSULTANT gives instruction for its removal.

##### **General:**

1. Remove labels after work is completed.
2. Wash and polish both faces not more than seven days prior to Owner's acceptance of work.
3. Comply with glass manufacturer's recommendations for final cleaning.

#### **7.16.14 Method Of Measurements**

For sliding glass doors the following shall be measured as per unit of number for each opening.

For other glass work, the work shall be measured in square meters and the rates shall be inclusive of the framework, SS studs, SS patch fittings of approved make unless otherwise mentioned.

The rates shall be inclusive of making holes, edge polishing using diamond, cutting, cleaning of glass, protection tapes, gaskets, sealants, and PVC edge tapes, frosting, acid finishing, etching etc.

**ALL HARDWARE SHALL BE AS PER THE THE SPECIFICATIONS OF CHATTISGARH SOR AND CPWD SPECIFICATIONS, NEW DELHI.**

## **7.17 Stainless Steel Work**

All steel work shall be 304 L grade stainless steel possessing a minimum of 18% chromium and 8% nickel, combined with a maximum of 0.08% carbon, non magnetic except S.S. cables and shall be free from defects impairing strength, durability or appearance and shall be of the best quality for the purpose specified, and possessing structural properties to withstand safely stresses to which these shall be normally subjected.

The contractor shall bear the costs of the tests.

All stainless steel members brought by the contractor shall be handled with care, stacked on edge and supported evenly. The stainless steel and rivet bars shall conform to latest edition of IS: codes. Before any fabrication work is commenced all surfaces shall be flattened. Method adopted for the purpose shall be such as not to inure the material. Cutting shall be the responsibility of the contractor. The contractor will have to submit shop drawings to the Consultant / Site Engineer. All shop drawing shall be prepared in advance of the actual fabrication. These shall show full size sections and all joints and connections, thickness of materials used and details of welds, bolts, rivets etc. Shop drawings shall clearly distinguish between, shop and field rivets, bolts and welds. Drawing shall be made in conformity with the IS: code for shop drawings and with due regard to speed and economy in fabrication and erection. A making diagram allotting distinct identification marks to each separate piece of steel shall be prepared. The diagram shall be sufficient to ensure convenient assembly and erection at site. All shop drawings shall show temporary bracing and connections required fabrication and erection.

### **7.17.1 Bolting**

All turned and fitted bolts shall be parallel throughout the barrel within the tolerance of only minus 0.13 mm and faces of heads and nuts bearing on stainless steel work shall be machined. All such bolts shall be provided with washers of standard size so that the nut when turned shall not bear on the unthreaded body of the bolt. Heads and nuts shall be hexagonal whit worth screws and shall be well formed. Where the full bearing area of the rivet is to be developed, the threaded portion of the bolt shall not be within the thickness of the parts bolted together. Threaded portion of each bolt shall project beyond the nut at least by one thread. Tapered washers shall be provided for all heads and butts bearing on beveled surfaces.

### **7.17.2 Welding**

Welding wherever indicated shall be argon arc welding unless otherwise specified. Welding shall be carried out by experienced welders only, who if necessary, shall produce testimonials about their work or if required by Consultant / Site Engineer shall have to undergo qualifying tests as prescribed in latest edition of IS: standards. Welding work shall be carried out as per latest edition of IS: codes for Stainless steel.

Welding shall be done in flat position wherever possible and adequate steps shall be taken to maintain the correct arc length, rate of travel, current and polarity for the type of electrode and nature of work.

Stainless Steel shall not be painted or oiled and any areas where welding is to be performed shall be well cleaned to remove any paint, scale or any contamination immediately before welding for a distance of at least 2 cm (3/4") on either side.

The work shall be securely held in position by means of tack welds, service bolts, clamps or jigs before commencing the welding so as to prevent any relative movement due to distortion, wind or other causes. When welding is liable to cause distortion, the work shall be securely held in approved frames or jigs.

Parts to be filler welded shall be brought in as close contact as practicable and in no event shall be separated more than 4.75 mm (3/16"). If the separation is 1.6 mm (1/16"), or greater, the size of the fillet welds shall be increased by the amount of the separation.

The separation between facing surfaces of lap joints shall not exceed 1.6 mm (1/16"). The fit of joints at contact surfaces which are not completely sealed by welds, shall be close enough to exclude water after painting.

Abutting parts to be butt welded shall be carefully aligned. Misalignment greater than 3 mm (1/8") shall be corrected and in making the correction, the parts shall not be drawn a sharper slope than two degrees (11mm in 30 cm or 7/16" in 12").

The sequence of welding shall be such that when possible the members which offer the greatest resistance to compression are welded first.

Welded joints showing slag inclusion or lack of proper penetration shall be cut and re welded overlap of the toe of the weld and undercutting of the parent metal should be avoided and where present to a serious extent shall be rectified.

All slag shall be removed from each run before another run is superimposed. When cold the final run shall be protected with clean boiled linseed oil and shall not be painted until approved by the Architect/Consultant or his representative.

Grinding of finished weld is permitted provided the weld is not reduced below the prescribed section. All exposed welds shall be ground smooth.

### **7.17.3 Uni-Direction**

All grinding and polishing to be done with uni-directional finishes where polishing must be carried out in the direction of the pattern of the rest of the satin finish surfaces. Tube to tube joining is to be done with spigot.

### **7.17.4 Fabrication And Erection**

In order to facilities handling, transportation and execution contractor may fabricate structural members in suitable sections. The details of site connection and their location shall be approved by the Consultant / Site Engineer.

Frame or lattice section intended for use as parts of composite construction which are likely deflect considerably during handling shall be suitably stiffened by means of steel angles.

Roof and other structure shall be supported at close intervals during the welding/bolting or site connections.

The frame of steel skeleton building shall be carried up true and plumb and temporary bracings shall be introduced wherever necessary to take care of all loads to which structures may be subjected including erection equipment and operation of the same, such bracing shall be kept in position as long as required for safety or as deemed necessary by the Consultant / Site Engineer.

As erection progresses, the work shall be securely bolted to take care of all dead load, wind load and erection stresses. No riveting or welding shall be done until the structure has been properly aligned. Rivets driven in field shall be heated and driven with the same care as those driven in the shop.

In the setting or erection of steel work the individual pieces shall be considered plumb or level when error does not exceed 1 to 500. For exterior columns the error shall not exceed 1 to 1000.

Slight bends in the members of fabricated structure shall not be straightened unless strictly necessary on account of danger of overstraining connection and rivets, weld or bolts. Connection plates, if slightly bent or twisted shall be straightened cold. If bent so sharply as to require heating the whole piece thus heated

shall be subsequently annealed. No straightening whatsoever shall be carried out without the previous sanctions of the Consultant / Site Engineer.

#### **7.17.5 Polishing And Buffing**

All the exposed surfaces to be satin finish polished. For polishing, black emery, brown tripoli, and spiral sewn buffing wheels shall be used. All buffing wheels and felt cones should be mounted on 1/4" shanks, for use with an electric drill.

#### **7.17.6 Fixing Of S.S. Flats**

Workmanship: The SS flats shall be fixed firmly in straight and erect position using mechanical tools. The SS flats exposed surfaces shall be satin finish polished. For polishing, black emery, brown Tripoli, and spiral sewn buffing wheels shall be used. All buffing wheels and felt cones should be mounted on 1/4" shanks, for use with an electric drill.

#### **Measurements**

All fabricated pipes, cables, sheets, etc. shall be calculated on the basis standard net weight / length according to I.S.I. code. Net weight of clean, brackets, packing pieces, rivets, bolts distance pieces, separators, and gussets holding down bolts, fish plates, etc shall be added to the respective items. No deduction shall be made for holes, bolts or rivets and waste involved in cutting or nothing ends of sections or intermediate points for making connections. Weights for the bolts and nuts shall be measured but the weight of the weld shall not be considered. Rates shall be inclusive of erection equipments, tools, tackles, machinery, argon welding, buffing and satin polishing etc equipments, scaffolding and labour. Rates shall be also inclusive of argon welding of SS members with M.S. members and finishing the surface properly to have a even and clean look.



## C.8 Roofing And Ceiling

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### 8.1 Terminology

**Accessories** : Purpose made fittings, such as apron flashing pieces, barge boards, bottom glazing flashing, corner piece (corner flashing), eaves filler pieces, expansion joints, hip capping, hip tile or cap, ridge capping, ridge finials, roof lights, ventilators, with which the roof is furnished.

**Eaves** : The lower edge of the inclined roof.

**Finial** : A decorative fitting used at the junction or ridges and hips to form a water proof covering and at the top of conical, pyramidal, or dome roofs.

**Flashing** : A strip of impervious material, usually metal used to exclude water from the junction between a roof covering and another part of the structure.

**Gable** : Part of wall above the general eaves level at the end of ridged or partially hipped roof.

**Gutter** : Any form of roof water channel.

**Hip** : The outer angle (more than 180 degree) formed by the inclined ridge between two intersecting roof slopes.

**Pitch**: The angle of inclination with the horizontal of the rafters or substructure surface on which the roof coverings are laid. In patent glazing, the angle at which the plane of a stretch of glazing is inclined to the horizontal.

**Pitched Roof** : A roof the pitch of which is greater than 10 degree to the horizontal.

**Ridge** : The horizontal intersection at the apex of the two rising roof surfaces inclined in opposite directions.

**Valley** : The re-entrant angle formed by the intersection of two inclined roof surfaces.

### 8.2 Material

Material should be used as specified in the item and shall conform to:

- i) C.G.S. sheets shall conform to IS: 277 and having zinc coating of 750 grade.
- ii) The A.C. sheets shall conform to IS: 459
- iii) The blown bitumen to be used for water proofing treatment shall conform to IS: 702
- iv) The P.V.C. flooring material shall conform to IS 3461-1986 and it shall consist of thoroughly blended composition of thermoplastic binder, filler and pigments.
- v) Rubber tiles flooring shall conform to I.S. 809-1970 and shall be of the sizes as shown in the drawing.
- vi) All the fittings and fixtures used shall be of approved quality.
- vii) Gypsum and calcium silicate boards of approved quality.

### 8.3 Laying

sheets shall be laid on the purlins to a true plane, with the lines of corrugations parallel or normal to the sides of the area to be covered unless otherwise required as in special shaped roofs.

The sheets shall be laid with a minimum lap of 15 cm at the ends and 2 ridges of corrugations at each side. The above minimum end lap of 15 cm shall apply to slopes of 1 vertical to 2 horizontal and steeper slopes. For flatter slopes the minimum permissible end lap shall be 20 cm. The minimum lap of sheets

with ridge, hip and valley shall be 20 cm measured at right angles to the line of the ridge, hip and valley respectively. These sheets shall be cut to suit the dimensions or shapes of the roof, either along their length or their width or in a slant across their lines of corrugations at hips and valleys. They shall be cut carefully with a straight edge chisel to give a smooth and straight finish.

Lapping in C.G.S sheets shall be painted with a coat of approved steel primer and two coats of painting with approved paint suitable for G.S. sheet, before the sheets are fixed in place.

Sheets shall be fixed to the purlins or other roof members such as hip or valley rafters etc. with galvanised J or L hook bolts and nuts, 8 mm diameter, with bitumen and G.I. limpet washers or with a limpet washer filled with white lead as directed by the Engineer-in-Charge. While J hooks are used for fixing sheets on angle iron purlins, and L hooks are used for fixing to R.S. joists, timber or precast concrete purlins. The length of the hook bolt shall be varied to suit the particular requirements. The bolts shall be sufficiently long so that after fixing they project above the top of the nuts by not less than 10 mm. The grip of J or L hook bolt on the side of the purlin shall not be less than 25 mm. There shall be a minimum of three hook bolts placed at the ridges of corrugations in each sheet on every purlin and their spacing shall not exceed 30 cm. Coach screws shall not be used for fixing sheets to purlins.

**Wind Tie :** Wind ties shall be of 40 x 6 mm flat iron section or of other size as specified. These shall be fixed at the eaves of the sheets. The fixing shall be done with the same hook bolts which secure the sheets to the purlins. The ties shall be paid for separately unless described in the item of roofing.

Gypsum sheet and Calcium silicate false ceiling shall be laid as per the specifications of the Bills of Quantities and as per the recommendations and technical manuals of the manufacturers.

Dry wall partitions using gypsum board shall be erected as per designs of the consultants and in profiles and angles as desired. The aluminium framing shall be first erected in order to receive the 12mm thick fire resistant gypsum boards. Cut outs in dry wall partitions shall be made by the contractor in order to accommodate electrical and other service lines. No extra shall claimed by the contractor to make such cut out openings for any of the services and electrical fittings. No deductions for such cut outs shall be made from the contractors measurements. The contractor shall apply two coats of acrylic putty after filling the joints of the boards using jointing tapes and compounds as per the directions of the manufacturer. The rates shall be inclusive of all of the above including all kinds of labour and materials and erections equipments and scaffolding. The contractor shall produce samples on site on the request of the Engineer in charge and the Consultants at no extra charges for approvals prior to start of work.

## 8.4 Measurement

The length and breadth shall be measured correct to a cm. for sheet roofing **and false ceiling**. Area shall be worked out in sqm correct to two places of decimal. The superficial area of roof covering shall be measured on the flat without allowance for laps and corrugations. Portion of roof covering overlapping the ridge or hip etc. shall be included in the measurements of the roof. No separate measurement shall be made for priming/ painting coat on overlaps of CGS sheets and for J or L hooks, bolts and nuts, galvanized iron seam bolts and nuts, bituminous and galvanized iron limpet washers etc.

Length and breadth shall be measured correct to a cm. The measurements shall be taken for the finished work, (mud phuska a terracing stipulated thickness with mud plaster, gobi leaping and flat tile paving and grouting) over the tiled surface, in superficial area.

The items for which the unit of measurement is square meter, the length and breadth shall be measured correct to a cm. and area shall be work out in square meter correct to two place of decimal.

The items for which the unit of measurement is running meter, the length shall be measured correct to centimeter.

The items for which the unit of measurement is each, the items shall be enumerated.

## **8.5 Rates**

The rate of this chapter includes cost of all material, labour, hardware, T&P, wastages, scaffolding, curing and hire & running charges of machinery etc. required to execute the work.

## C.8 Roofing Works

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### 8.1 Panel Rib – Tata Bluescope Sheets For Ceilings And Wall Panelling

Supply and fixing of HI RIB roofing system manufactured out of 0.50mmTCT (Total Coated Thickness) high tensile zinc aluminum alloy coated with an alloy about 55% aluminum, 43.5% zinc&1.5% silicon bare Galvalume high tensile cold rolled steel as per AS 1397, coating class AZ 150 (min. 150 gms/m<sup>2</sup>Zinc aluminum alloy coating mass, total both side 550 Mpa yield strength) conforming to AS 1397/ASTM A792. Sheets to have wide pans and 28-30mm.Hi-Ribs at 200-250 mm Centers and a cover width of 1010 mm and an overall width of 1050-1060mm. Sheets shall be fixed by means or self-drilling self-tapping hot dip zinc coated climaseal polymer coated hexed fasteners of size 12x14x55mm long. The sheets shall be supplied in custom lengths and fixed as per drawings and details. The end lap of sheet be 150 mm and sealed with silicon sealant. When provided as lost formwork in the ceiling, the same will have to have a coating of bond coat on the surface to be bonded with RCC. The bond coat to be applied as per manufacturer's directions and specifications. Sheet to be Panel rib of TATA blue scope or equivalent. Only finished measurements will be paid for. The end lap of sheet to be 150mm and sealed with Structural silicone sealant of Dow Corning or equivalent.

### 8.2 Workmanship

The work shall be carried out as per the designs and shall correctly match the profiles as per the drawings of the Consultant. The contractor shall not use/ discard any defective sheet. The Panel rib sheets used shall be checked for any kinds of cracks, breaking etc prior to and after installation.

The sheets shall be fixed firmly with the RCC ceilings with the help of lugs made of reinforcement bars at equally spaced distances as shown in the design drawings of the consultant. The sheet shall be flush with the RCC surface and shall not be damaged during the working. The contractor shall ensure that the sheet is firmly attached with the ceiling as per the details of the consultant.

The work shall be measured in square meters. The rates shall be inclusive of all kinds of scaffolding, staging, materials, labour, aluminum clamping profiles (powder coated or anodized as per the requirements of the consultants), rubber profiles, hardware etc. Plan area only shall be measured. In any other case guidelines of IS 1200 shall be followed.

### 8.3 Trimdeck – Tata Bluescope Sheets For Roofing Works

Supply of HI RIB roofing system manufactured out of 0.50mmTCT (Total Coated Thickness) Hi-Tensile Bare Galvalume Steel (AZ-150gsm zinc / alum alloy coating total of both sides as per AS 1397) having 550Mpa yield strength. The weathering surface to be given a finish coat of nominal 20 micron of SMP Paint and rear side to have neutral back coating nominal 5 micron. The sheets shall have 1010mm covered width, 28-30mm high crests at 250-255mm centres with wide pans for effective water shedding. The side laps are with special male / female side laps and anti-siphoning feature to prevent leakages. The pan shall be stiffened by using 3 small ribs. The outer sheeting shall be fixed with self-drilling screws (12-14 x 20) on to the purlins. The sheets shall be supplied in custom lengths and for a maximum up to 12 mts. Sheet to be **TRIMDEC** of TATA blue scope or equivalent, only finished measurements will be paid for. (For ROOFING)

## **8.4 Workmanship**

The work shall be carried out as per the designs and shall correctly match the profiles as per the drawings of the Consultant. The contractor shall not use/ discard any defective sheet. The TRIMDECK sheets used shall be checked for any kinds of cracks, breaking etc prior to and after installation.

The sheets shall be fixed firmly with the truss members/ purlins with the help of correct size self drilling epoxy coated screws as shown in the technical manuals of the manufacturer. The sheet shall be either flush or projecting as shown in the designs and shall not be damaged during the working. The contractor shall ensure that the sheet is firmly attached with the truss/ purlins/ cleats as per the details of the consultant.

The work shall be measured in square meters. The rates shall be inclusive of all kinds of scaffolding, staging, materials, labour, aluminum clamping profiles (powder coated or anodized as per the requirements of the consultants), rubber profiles, hardware, erecting equipments like cranes, hydraulic cranes, chain and pulley etc. Actual area of roofing done only shall be measured. In any other case guidelines of IS 1200 shall be followed.

## **8.5 Polycarbonate**

Multi wall Polycarbonate sheets for roofing shall be of the best quality such as Bayer Markrolon, GE-Lexan or equivalent as approved by the Consultant. It shall meet all the requirements of BS: 6262. For impact performance, it shall meet the BS: 6206 requirements and for anti bending requirements it shall conform to BS: 5544.

### **8.5.1 Scope Of Work**

The contractor shall supply and install polycarbonate roofing of specified thickness and strength as per the Bills of quantities, design drawings and as per the instructions of the Consultant / Engineer in charge. All materials shall be delivered to site with manufacturer name or trade make in specific lengths as per the manufacturer. The contractor shall be required to produce shop drawings and get the same approved from the consultant prior to start of work.

### **8.5.2 Workmanship**

The work shall be carried out as per the designs and shall correctly match the profiles as per the drawings of the Consultant. The contractor shall not use/ discard any defective sheet. The multi wall polycarbonate sheets used shall be checked for any kinds of cracks, breaking etc prior to and after installation.

The aluminum clamping profiles shall be used to install the polycarbonate sheets. The aluminum profiles shall be from reputed companies and IS certified. The profiles shall be approved prior to use. The polycarbonate sheets shall be firmly inserted in the aluminum clamping profiles and fixed to position using setting blocks and dry rubber matching profiles. Screwing shall be done in the aluminum clamps using nuts and washers firmly to hold the assembly in position. No screwing shall be directly done in the polycarbonate sheets. This shall strictly not be allowed.

The system once installed and erected in desired position, shall be checked for water leakages. If any leakage found, the same shall be immediately checked and resolved and rectified on site. The contractor shall provide a written guarantee against leakages.

The multi wall polycarbonate roofing shall be installed in a manner as to cater to a wind speed of 50m/s and shall conform to the requirements of IS 875 - latest edition for uplift and other requirements. The assembly of the polycarbonate sheeting shall be firmly secured in position by screwing and securing them with the M.S. structure beneath as shown in the design drawings of the Consultants.

## **8.6 Method Of Measurements**

The work shall be measured in square meters. The rates shall be inclusive of all kinds of scaffolding, staging, materials, labour, aluminum clamping profiles (powder coated or anodized as per the requirements of the consultants), rubber profiles, hardware etc. Plan area only shall be measured. In any other case guidelines of IS 1200 shall be followed.

## C.15 Plastering And Pointing

### 15.1 Materials

The following materials are to be used in plastering:

- i) **Cement:-** The specification of cement shall be same as described in chapter 3.
- ii) **Water:-** The specification of water shall be same as described in chapter 3
- iii) **Fine Aggregates:** - Aggregate most of which passes through 4.75 mm IS sieve is known as fine aggregate. Fine aggregate shall consist of natural sand, crushed stone sand or crushed gravel sand stone dust or marble dust, fly ash and surkhi (crushed brick and cinder) conforming to IS:2686-1977. It shall be hard, durable, chemically inert, clean and free from adherent coatings, organic matter etc. and shall not contain any appreciable amount of clay balls or pellets and harmful impurities e.g iron pyrites, alkalies, salts coal, mica, shale or similar laminated materials in such form or in such quantities as to cause corrosion of metal or affect adversely the hardening, the strength, the durability or the appearances of mortar, plaster or concrete. The sum of the percentage of all deleterious material shall not exceed 5%. Fine aggregate must be checked for organic impurities such as decayed vegetation humps, coal dust etc. as per IS:2386 (Part II) 1963.

The maximum quantity of silt in sand shall not exceed 8 %. Fine aggregate containing more than allowable percentage of silt shall be washed so as to bring the silt content within allowable limits for which nothing extra shall be paid.

Sand requiring use for mortar for plaster work shall confirm to IS:1542-1977. Grading of sand should be as given below:

#### GRADING OF SAND FOR USE IN PLASTER AS PER IS:1542-1977

IS Sieve Designation	Percentage passing
10mm	100
4.75mm	95 - 100
2.36mm	95 – 100
1.18mm	90 - 100
600 micron	80 - 100
300 micron	20 – 65
150 micron	0 - 50

### 15.2 Preparation Of Surface

The joints shall be raked out properly. Dust and loose mortar shall be brushed out. Efflorescence if any shall be removed by brushing and scrapping. The surface shall then be thoroughly washed with water, cleaned and kept wet before plastering is commenced.

In case of concrete surface if a chemical retarder has been applied to the form work , the surface shall be roughened by wire brushing and all the resulting dust and loose particles cleaned off and care shall be taken that none of the retarders is left on the surface.

### 15.3 Mortar

The mortar of the specified mix shall be used.

## **15.4 Scaffolding**

For all exposed brick work or tile work, double scaffolding independent of the work having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding planks shall be fixed.

For all other brick work in buildings, single scaffolding shall be permitted. In such cases the inner end of the horizontal scaffolding pole shall rest in a hole provided only in the header course for the purpose. Only one header for each pole shall be left out. Such holes for scaffolding shall, however, not be allowed in pillars/ columns less than one metre in width or immediately near the skew backs of arches. The holes left in masonry works for scaffolding purposes shall be filled and made good before plastering.

## **15.5 Application Of Plaster**

Ceiling plaster shall be completed before commencement of wall plaster.

Plastering shall be started from the top and worked down towards the floor. All putlog holes shall be properly filled in advance of the plastering as the scaffolding is being taken down. To ensure even thickness and a true surface, plaster about 15x15 cm shall be first applied, horizontally and vertically, at not more than 2 metres intervals over the entire surface to serve as gauges. The surfaces of these gauged areas shall be truly in the plane of the finished plaster surface. The mortar shall then be laid on the wall, between the gauges with trowel. The mortar shall be applied in a uniform surface slightly more than the specified thickness. This shall be beaten with thin strips of bamboo about one metre long to ensure through filling of the joints, and then brought to a true surface, by working a wooden straight edge reaching across the gauges, with small upward and side ways movements at a time. Finally the surface shall be finished off true with trowel or wooden float according as a smooth or a sandy granular texture is required. Excessive troweling or over working the float shall be avoided. During this process, a solution of lime putty shall be applied on the surface to make the later workable.

All corners, arrises, angles and junctions shall be truly vertical or horizontal as the case may be and shall be carefully finished. Rounding or chamfering corners, arrises, provision of grooves at junctions etc. where required shall be done without any extra payment. Such rounding, chamfering or grooving shall be carried out with proper templates or battens to the sizes required. No portion of the surface shall be left out initially to be patched up later on.

## **15.6 Finish**

The plaster shall be finished to a true and plumb surface and to the proper degree of smoothness as required. The work shall be tested frequently as the work precedes with a true straight edge not less than 2.5m long and with plumb bobs. All horizontal lines and surfaces shall be tested with a level and all jambs and corners with a plumb bob as the work proceeds.

## **15.7 Thickness**

The thickness of the plaster specified shall be measured exclusive of the thickness of key ie grooves or open joints in brick work. The average thickness of plaster shall not be less than the specified thickness. The minimum thickness over any portion of the surface shall not be less than specified thickness by more than 3 mm. The average thickness should be regulated at the time of plastering by keeping suitable thickness of the gauges. Extra thickness required in of wall or in plastering of masonry cornices etc. will be ignored.

## **15.8 Curing**

Curing shall be started 24 hours after finishing the plaster. The plaster shall be kept wet for a period of seven days. During this period, it shall be suitably protected from all damages at the contractor's expense



by such means as the Engineer-in-Charge may approve. The dates on which the plastering is done shall be legibly marked on the various sections plastered so that curing for the specified period there after can be watched.

## 15.9 Precaution

Any cracks which appear in the surface and all portions which sound hollow when tapped, or are found to be soft or otherwise defective, shall be cut out in rectangular shape and redone as directed by the Engineer-in-Charge.

- i) When ceiling plaster is done, it shall be finished to chamfered edge at an angle at its junction with a suitable tool when plaster is being done, it shall be kept separate from the ceiling plaster by a thin straight groove not deeper than 6 mm drawn with any suitable method with the wall while the plaster is green
- ii) To prevent surface cracks appearing between junction of column/ beam and walls, 150 mm wide chicken wire mesh should be fixed with U nails 150 mm centre to centre before plastering the junction. The plastering of wall and beam/ column in one vertical plane should be carried out in one go. For providing and fixing chicken wire mesh with U nails payment shall be made separately.

## 15.10 Measurement

Length and breadth shall be measured correct to a cm and its area shall be calculated in square metres correct to two places of decimal

Thickness of the plaster shall be exclusive of the thickness of the key i.e. grooves, or open joints in brick work.

The measurement of wall plaster shall be taken between the walls or partitions (the dimensions before the plaster shall be taken) for the length and from the top of the floor or skirting to the ceiling for the height. Depth of coves of cornices if any shall be deducted.

A coefficient of 1.63 shall be adopted for the measurement of one side plastering on honey comb work having 6x10cm opening.

Deduction in measurement, for opening etc, will be regulated as follows:

- a) No deduction will be made for opening or ends of joists, beams, posts, griders, steps etc. upto 0.5 sqm in area and no additions shall be made either, for the jambs, soffits and sills of such openings. The above procedure will apply to both faces of wall.
- b) Deduction for opening exceeding 0.5 sqm but not exceeding 3 sqm each shall be made for reveals, jambs, soffits sills, sills etc. of these openings.
  - i) When both faces of walls are plastered with same plaster, deductions shall be made for one face only.
  - ii) When two faces of walls are plastered with different types of plaster or if one face is plastered and other is pointed or one face is plastered and other is unplastered, deduction shall be made from the plaster or pointing on the side of the frame for the doors, windows etc. on which width of reveals is less than that on the other side but on deduction shall be made on the other side.

Where width of reveals on both faces of wall are equal, deduction of 50% of area of opening on each face shall be made from area of plaster and/or pointing as the case may be.

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- iii) For opening having door frame equal to or projecting beyond thickness of wall, full deduction for opening shall be made from each plastered face of wall.
- c) In case opening of area above 3 sqm each, deduction shall be made for the openings from both sides of the walls, but jambs, soffits and sills shall be measured.

### **15.11 Rate**

The rate shall include the cost of all labour and materials, T&P, Scaffolding , all heights,leads & lifts involved in execution of the work.

## C.15.1 Flooring

### 15.1.1 Material

The material to be used in flooring shall be as follows:

- i) **Cement** : The specification for the cement will be same as prescribed in chapter No. 3
- ii) **Water**: The specification for the Water will be same as prescribed in chapter No. 3
- iii) **Aggregate** : The specification for the Fine and Coarse Aggregate will be same as prescribed in chapter No. 3
- iv) **Terrazzo Flooring**: Marble chips/ terrazzo floors, skirting and dados shall conform to IS: 2114-1984. Marble powder used in mosaic/terrazzo topping shall pass through IS: sieve No.30. Pigments used in terrazzo/marble chips shall be of permanent colour.
- v) **Precast Terrazzo tile**: Precast terrazzo tiles shall conform to IS: 1237-1959 and overall thickness of chequerred tiles should not be less than 22mm. The grooves in the chequerred shall be uniform and straight. The depth of the groove shall not be less than 3.0mm.
- vi) **Glazed Tiles**: The glazed tiles white/ coloured, shall be of approved make and shall conform to IS: 777-1970. The top surface of the tiles shall be glazed. The glazed shall be either glossy or matt as specified. They shall be flat & true to shape and free from crack, crazing spots, chipped edges and corners. The glazing shall be of uniform shade.
- vii) **Precast Cement Concrete Tile**: Precast Cement concrete tiles shall conform to IS: 1237-1980 and overall thickness of tiles should not be less than 22mm. The grooves in the chequerred shall be uniform and straight.
- viii) **Marble Stone**: Marble shall be hard, sound, dense and homogeneous in texture with crystalline texture. It shall be uniform in colour and free from stains, crackes, decays and weathering.

#### PHYSICAL PROPERTIES OF MARBLE BLOCKS, SLABS AND TILES

S. N	Characteristics	Requirements	Method of Test.
1.	Moisture absorption after 24 hours immersion in cold water	Max. 0.40 % by weight	IS: 1124-1974
2.	Hardness	Min. -3	Mhos scale
3.	Specific gravity	Min. -2.50	IS: 1122-1974

- ix) **Granite Stone**: Granite stone shall be hard, sound, dense and homogeneous in texture with crystalline texture. It shall be uniform in colour and free from stains, crackes, decays and weathering.
- x) **Kota Stone**: Kota stone slabs/tiles shall be of selected quality, hard, sound, dense and homogeneous in texture, free from cracks, decay, weathering and flaws. They shall be hand or machine cut in requisite thickness.
- xi) **Red/White/Coloured Sand Stone**: The slabs of white, red and stones of other colours found at Shivpuri, Mandana, Jaisalmer, Dholpur, Basoda, Raisen and at other places to be used in flooring work shall be hard, durable and tough, free from cracks, decays and weathering. In case of red sand stones and other coloured sand stones, white patches or streaks and in case of white sand stones. Coloured patches or streaks shall not be allowed. However, scattered spots upto 10mm diameter shall be permitted.
- xii) **Wooden Flooring** :The wooden flooring shall conform to IS: 3670-1966. The wood used for the flooring should be of superior quality

### **15.1.2 Laying**

- i) The flooring should be laid of the material as specified in the item and on the base of specified mortar. The top surface of the flooring should be in a true surface with the required slope. The thickness of the flooring should be as specified.
- ii) The joints in the stone/ tiles flooring shall be of 1.50mm thick. The joints shall be filled with the cement grout of the same shade as the colour of stone or tile. The edges of the cut tile/ stone should be rubbed smooth to ensure state true joint the size of the stone/tile should be as specified.

### **15.1.3 Curing**

The curing shall be done for a minimum period of 7 days. Curing shall not be commenced until the top layer has hardened.

### **15.1.4 Polishing**

The stone/ tile flooring shall be grinded with carborandom stone. The first grinding shall be with carborandom stones of 48 to 60 grit size and the second grinding with 120 grit and final grinding with 220 to 350 grit. In case of plain/ coloured terrazzo tiles, initial grinding with carborandom stones of 48 to 60 grit is not necessary.

Polishing of for the situ marble chips/terrazzo flooring shall be done by machine the first grinding shall be done with carborandom stone of 60 grit size after about 36 hours of laying the top layer. The second grinding with 80 grit size and the third grinding with 120 to 150 grit size and the fourth grinding with 320 to 400 grit size.

### **15.1.5 Measurement**

Length and breadth shall be measured correct to a cm and area as laid shall be calculated in square metres correct to two places of decimal. Length and breadth shall be measured before laying skirting, dado or wall plaster. No deduction shall be made not extra paid for voids not exceeding 0.20 sqm Deduction for ends of dissimilar material or other articles embedded shall not be made for areas not exceeding 0.10 sqm.

The thickness of the skirting shall be as stated. Length shall be measured along the finished face of riser, skirting or dado correct to a cm. Height shall be measured from the finished level of tread or floor to the top (the underside of tread in the case of steps). The height shall be measured correct to 5mm in case of risers and skirting 30 cm in height. correct to 1 cm in case height is more than 30 cm. The area shall be calculated in square meter, correct to two places of decimal

The flooring provided with kite or other complicated pattern will be paid for extra over the relevant item.

The strip upto 150mm width provided in the flooring will be paid for extra over the relevant item.

The granite/ Jaisalmer stone strip (10mm wide) will be not measured is running meter and will not be deducted from the relevant flooring.

The aluminium/ glass strips shall be measured in running meter correct to centimeter.

### **15.1.6 Rate**

The rates include cost of all materials, labour, T & P, wastages, water for curing, hire & running charges of all type of machineries required and all lead & lifts of all materials etc. complete

## 15.1.7 Marble Work (Wall Lining)

### 15.1.7.1 Properties Of Marble

Marble slab to be used in wall lining shall be hard, sound, dense, homogeneous and of uniform texture. It shall be uniform in colour and free from stains, cracks, decay and weathering. As far as possible single stone slab shall be used for wall lining but in no case more than 2 slabs shall be permitted to be used to cover the wall height.

### 15.1.7.2 Classification Of Marble

The marble blocks, slabs and tiles shall be classified broadly in the following two categories :

- (i) White Marble
- (ii) Coloured Marble such as black, green, pink, brown, grey marble etc.

The marble wall shall be of required thickness and as per pattern specified. All exposed faces shall be fine tooled to a uniform finish. Fixing shall be done with the adjoining working grooves, rivets etc. as shown in the drawing or as specified by the Engineer-in-Charge

### 15.1.7.3 Sizes And Tolerances

The size of marble blocks, slabs and tiles shall be as mentioned in Table 1.

**TABLE 1- Sizes of Marble Blocks, Slabs and Tiles**

	Length	Width	Thickness
1. Blocks	30 to 250	30 to 100	30 to 90
2. Slabs	70 to 250	30 to 100	2 to 15
3. Tiles	10 to 60	10 to 60	0.8 to 2.4

#### Notes :

- (1) All dimensions are in centimetre.
- (2) The length and width, of the blocks shall be in multiple of 30 cm.
- (3) Length and width of slab shall be in multiple of 10 cm. and thickness in multiple of 1 cm.
- (4) Tiles shall be square cut and linear dimensions in multiple of 10 cm.
- (5) Only slabs and tiles shall be machine cut and factory made.
- (6) For 8 mm thick tiles, special precautions will be required for fixing them like using special adhesive as per manufacturer's specifications. Such tiles are not suitable for outside veneering work exposed to rains/sun if used in large areas in continuous stretches. For tiles of thickness 20 mm and above cramps may be provided if approved by Engineer-in-Charge.

#### TOLERANCE

The following tolerances shall be allowed in the dimension of blocks, slabs and tiles:

#### Tolerance

Blocks

- (a) Length + 2 per cent
- (b) Width + 2 per cent
- (c) Thickness + 2 per cent

Slabs

- (a) Length + 2 per cent
- (b) Width + 2 per cent
- (c) Thickness + 3 per cent

Tiles

- (a) Linear dimension + 3 per cent
- (b) Thickness + 1 per cent

The sizes other than those mentioned above may be provided as directed by the Engineer-in-Charge and nothing extra shall be payable on this account.

#### **15.1.7.4 Dressing And Rubbing**

Every marble stone shall be cut to the required size and shape, chisel dressed on all beds and joints, so as to be free from any waviness and to give truly vertical, horizontal, radial or circular joints as required. The exposed faces and sides of stones forming joints upto 6mm. from the face shall be fine tooled such that a straight edge laid along the face of the stone is in contact with every point on it. These surfaces shall then be rubbed smooth. All visible angles and edges shall be true, square and free from chipping. Beyond the depth of 6 mm from face, the joints shall be dressed with a slight splay so that the thickness of joint increases, in an inverted V shape. The surfaces of the stones coming in contact with backing need not be chisel dressed.

A sample of dressed and rubbed stone shall be prepared for approval and it shall be kept on worksite after being approved by the Engineer-in-Charge.

#### **15.1.7.5 Mortar**

The mortar used for jointing shall be as specified.

#### **15.1.7.6 Laying**

All marble stones shall be wetted before placing in position. These shall then be floated on mortar and bedded properly in position with wooden mallets without the use of chips or under pinning of any sort.

The walls and pillars shall be carried up truly in plumb or battered as shown in the drawings. All courses shall be laid truly horizontal and all vertical joints shall be truly vertical.

In case of work without backing of brick work or coursed rubble masonry, face stone shall be laid headers and stretchers alternatively unless otherwise directed. The headers shall be arranged to come as nearly as possible in the middle of stretchers above and below. Stone shall be laid in regular courses of not less than 15 cm in height and all courses shall be of the same height unless otherwise specified.

For work facing with backing of brick work or coursed rubble masonry, face stone shall be laid in alternate courses of header and stretchers unless otherwise directed. Face stone and bond stone courses shall have break joint on the face of atleast half the height of the standard course and the bond shall be carefully maintained through out. All the connected masonry in a structure shall be carried up nearly at one uniform level throughout but where breaks are unavoidable the joints shall be made in good long steps so as to prevent cracks developing between new and old work.

When necessary jib crane or other mechanical appliances shall be used to hoist the heavy pieces of stones and place these in to correct positions, care being taken that the corners of the stone are not damaged. Stone shall be covered with gunny bags, before putting chain or rope is passed over it, and it shall be handled carefully. No piece which has been damaged shall be used in work. The matching of grains shall be carried out as directed by the Engineer-in-Charge.

If wall lining work is to be executed upto sill level, then the height will be covered in single stone only.

#### **15.1.7.7 Curing**

The work shall be kept constantly moist on all faces for a period of atleast seven days.

#### **15.1.7.8 MEASUREMENTS**

For plain work : Measurements shall be taken correct to a cm. in length and breadth and correct to 0.5 cm. in thickness

#### **15.1.7.9 Rate**

The rates include cost of all materials, labour, T & P, wastages, water for curing, hire & running charges of all type of machineries required and all lead & lifts of all materials etc. complete

## **C.15.2 Distempering, Painting And Finishing**

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### **15.2.1 Material**

The following materials shall be used for finishing work:

- i) Class C lime i.e. fat lime shall be used for white washing,.
- ii) The colouring material shall be of approved make and as approved by Engineer-in-Charge for colour wash.
- iii) Dry distemper shall conform to I.S. 427-1965
- iv) Oil bound distemper shall conform to I.S. 428-1969
- v) Cement paint shall conform to I.S. 5410-1969.
- vi) Primer on wooden surfaces shall be ready to mixed primer conforming to I.S 3536.
- vii) Primer on metal steel surfaces shall be done with red oxide zinc chromate conforming to IS 2074.
- viii) Synthetic enamel paint shall conform to I.S. 2932 -1974, IS 2933-1975 and IS 133-1975
- ix) Ready mixed paints shall conform to I.S. 3631-1966.
- x) Clear synthetic varnish shall conform to IS 525-1968
- xi) Copal varnish shall conform to I.S. 337-1975.
- xii) Wax polishing shall be done with ready made wax polish.
- xiii) The other paints should conform to the following specifications:
  - a) Aluminium paint - IS 2339-1963
  - b) Black Japan - IS 341-1968
  - c) Anti corrosive Bituminous - IS 158-1969
  - d) Plastic emulsion paint - IS 5411-1974
  - e) French polish - IS 348-1968
  - f) Turpentine - IS 533-1973.
  - g) Double boiled linseed oil - IS 77-1968
  - h) Acrylic exterior paint - As per manufacturer specification.
  - i) Textured exterior paint - As per manufacturer specification.
  - j) Multi surface paint - As per manufacturer specification.
  - k) Oil type wood preservative - IS:218.

### **15.2.2 Preparation Of Surface**

#### **i) New Work**

The surface shall be thoroughly brushed to remove the mortar droppings and foreign matter before the work to be executed. New plaster surfaces shall be allowed to dry for at least two months before applying the finishing items.

All the rust, dirt, scales, smoke splashes, mortar dropping and grease shall be thoroughly removed from the surface for painting work.



The surface shall be cleaned and all unevenness shall be rubbed down smooth with sand paper and well dusted for polishing work. Knots if visible shall be covered with a preparation of red lead and glue size laid on while hot. Holes and indentations on the surface shall be stopped with glazier's putty.

**ii) Old Work**

All loose particles and scales shall be scrapped off and holes in plaster as well as patches of less than 50 cm area shall be filled up with mortar of the same mix.

All loose pieces and scales shall be removed by sand papering. The surface shall be cleaned of all grease, dirt etc. Pitting in plaster shall be made good with Plaster of Paris mixed with the color to be used. The surface shall then be rubbed down again with a fine grade sand paper and made smooth. A coat of the finishing item shall be applied over the patches. The patched surface shall be allowed to dry thoroughly before the regular coat of finishing item.

If the old polished surface is not much soiled then it shall be cleaned of grease and dirt by rubbing with turpentine and then rubbed with fine sand paper. If the old polished surface is much soiled then it will be necessary to remove the entire polish and the work will be executed as new work.

### **15.2.3 Scaffolding**

Wherever scaffolding is necessary, it shall be erected on double supports tied by horizontal pieces, over which scaffolding planks shall be fixed. No ballies, bamboos or planks shall rest on or touch the surface which is being finished. Where ladders are used, pieces of old gunny bags shall be tied on their tops to avoid damage or scratches to walls. For the ceiling, proper stage scaffolding shall be erected.

### **15.2.4 Application**

The finishing item shall be applied with appropriate brushes to the specified number of coats. The operation for each coat shall consist of a stroke of the brush given from the top downwards, another from the bottom upwards over the first stroke, and similarly one stroke horizontally from the right and another from the left before it dries. Each coat shall be allowed to dry before the next one is applied. Further each coat shall be inspected and approved by the Engineer-in-Charge before the subsequent coat is applied. No portion of the surface shall be left out initially to be patched up later on. The finished dry surface shall not show any signs of cracking and peeling nor shall it come off readily on the hand when rubbed.

### **15.2.5 Protective Measures**

Doors, Windows, floors, articles of furniture etc. and such other parts of the building not to be white washed, shall be protected from being splashed upon. Splashings and droppings, if any shall be removed by the contractor at his own cost and the surfaces cleaned. Damages if any to furniture or fittings and fixtures shall be recoverable from the contractor.

### **15.2.6 Measurement**

Length and breadth shall be measured correct to a cm and area shall be calculated in sqm correct to two places of decimals.

Corrugated surface shall be measured flat as fixed and the area so measured shall be increased by the following percentage to allow for the girthed area:

Corrugated Sheet	20%
Semi-corrugated Sheet	10%

In measuring painting, varnishing, oiling etc. of joinery and steel work etc. the coefficient as per IS:1200 of mode of measurement for building works, with further amendments if any shall be used to obtain the area payable.

The length shall be measured over the finished line of pipe including special etc. in running metre, correct to a cm.

In case of sponge/ sand faces (Non plain or equivalent) plastered surface of wall, the area measured, is to be multiplied by the factor 1.50 for payments of white wash, colour wash and distempering for one or more coats of required finish.

### **15.2.7 Rates**

The rates in this chapter are for all location like walls, ceiling, sloping roofs and in all floors and height and depths, and for all shades with cost of all materials, labour, scaffoldings, T & P, hire & running charges of machineries, ladders, cans, brushes and other appliances etc. required for the efficient execution of work.

#### **Silicon Paint**

It shall be of the best quality, like Hydroseal, siliconate epoxy or equivalent, as approved by the Consultant. It shall conform to the relevant IS codes.

It shall be prepared by mixing silicone and epoxy. It shall be applied on dry as well as damp surfaces. It shall be non-toxic and odourless, so shall be suitable for drinking water structures also. It shall be water based or solvent based as specified and as per the recommendations of the manufacturer. It shall render the surface impervious to water and shall prevent water penetration. It itself shall penetrate into the structure and shall form a strong film on the pores of the structure surface, making the surface water tight, non toxic and corrosion free. Before use the hardener of silicone epoxy shall be mixed with resin and thinned with either water or solvent, in the proportions described by the manufacturer. It shall be applied with a suitable spray gun or brush.

An overlap of 25-30cm shall be preferred. It shall be transparent in colour and shall not affect the characteristics, either physical or chemical of the base material. Contractor to provide a minimum guarantee for 10 years in solvent based system. The silicone paint shall be of Fosroc, STP, Sika make or equivalent.

**Method of measurement** - Length and breadth shall be measured correct to a cm and area shall be calculated in square meter correct to two places of decimals.

All works shall conform to relevant latest Indian Standard codes.

### **15.2.8 Indian Standards For Painting And Polishing Works**

Indian and other international standards followed for this section shall be as listed below. In case of any discrepancies or ambiguities noticed shall be brought to notice of the CONSULTANT and clarification/confirmation sought. His decision shall be final. However as a general rule more stringent specifications shall be followed.

- 1) IS 345                      Specification for wood filler, transparent, liquid
- 2) IS 533                      Specification for gum spirit of turpentine (oil of turpentine)
- 3) IS 1477 Code of practice for painting of ferrous metals in buildings
  - Part I                      Pretreatment
  - Part II                      Painting
- 4) IS 2388 Code of practice for finishing of wood and wood based Materials
  - Part I                      Operation and workmanship
  - Part II                      Schedule

- 5) IS 2524 Code of practice for non-ferrous metals in building
  - Part I Pretreatment
  - Part II Painting
- 6) IS 3537 Specification for ready mixed paint, finishing, interior, for general purposes to IS colours
- 7) IS 4597 Code of practice for finishing of wood and wood based products with nitrocellulose and cold catalyzed materials.
- 8) IS 6005 Code of practice for phosphating of iron and steel

### **15.2.9 Quality Assurance**

Contractor shall provide and use product of single manufacturer in each paint system unless it is advised by the paint manufacturer.

Paint shall not contain compound harmful for health and banned by the authorities.

Paint used shall be of approved make and conforming to IS requirements.

Contractor shall engage applicator with minimum three years experience.

### **15.2.10 Submittals**

Contractor shall submit product data of each product and cross-reference to specific paint system suggested in IS code of practice.

Submit colour chart identifying paint system to be applied to each area.

Prepare one sample of each paint system on timber/plywood. Step back each coat and process to show bare substrate, each coat and process in system build up.

Applicators experience certificate.

Manufacturer's confirmation that it meets IS requirements and his application instructions.

### **15.2.11 Warranty**

Contractor shall submit written warranty for free from defects material and workmanship

To repair and replace defects occurring during warranty period.

Defects include but not limited to pin holes, crazing and loss of adhesion to substrate, deficient thickness, bleed-through, improper material, defective material and workmanship.

### **15.2.12 Materials**

- 1) Paints used in works shall conform to the respective IS or equivalent, other international standard (if specifically specified) and code of practices. These shall be the latest revised.
- 2) Paints should be such as to withstand weathering effects of the atmosphere, decay of wood, corrosion of metal and of pleasing appearance.
- 3) All paints and finishes shall conform and subjected to test as per IS or international standards at least for following
  - Uniform film applicability with self-leveling properties.
  - Inert to weathering, accelerated weathering and oxidation.
  - Fading, colour fasteners, hard and durable surface.

## Civil Works - Specifications

- Bending and scratching resistances
  - Resistance to mould, fungus and algae.
  - Chemical analysis (particularly anti corrosive paints).
- 4) Thinners and tints used shall be of same manufacturer of approved paint brand or as recommended and approved by him for use with his products.
  - 5) Shellac, turpentine, patching and other similar materials required for execution of work shall be pure, best quality products.
  - 6) Product shall have an integral inhibitor added during manufacturing process for protection against fungus, algae and for mildew.
  - 7) Varnishes shall conform to the respective latest revised IS. Varnishes shall create a brightening appearance on wood, brilliancy to the painted surface and offer protection against atmospheric action.
  - 8) Good varnishes should achieve the following:
    - Render glossy/matt finish to the surface as specified.
    - Have a uniform, pleasing appearance on rapid drying.
    - Its colour should not fade.
    - Must ensure a final, durable and tough surface.
  - 9) Delivery

Material received at site shall have proper labels of approved manufacturer of paint/varnishes/polish, batch no., date, type and colour.

### 10) Storage

- Paint / Varnishes / Polish shall be in store in well-ventilated areas. Required care for prevention of fire shall be taken. Display prominently warning sign.
- Manufacturers seals and containers shall not be opened unless same is approved and required for use at site
- Store shall be maintained clean and neat by making sure that all waste, rags, etc. are removed at the end of each day.
- No container shall be kept open at any time.
- Prohibit smoking in store area and arrange fire protection equipment in area.

### 11) Testing

- Test required to be carried out as per direction of consultant shall be done at the cost of contractor.
- Samples and literature required shall be submitted to CONSULTANT by the contractor at no extra cost to contract.

## **15.2.13 Workmanship**

### **15.2.13.1 General**

Work shall be carried out strictly as per code of practices, recommendations of approved paint / polish manufacturer and direction of consultant. For general guidance expectation of consultant are as under.

It shall not be responsibility of the contractor to finish painting / polishing work in specified system/coats to acceptable finish appearance, texture, thickness shade. Extra coats or extra efforts if any required by him in execution shall not be paid additionally.

Painting/Polishing shall commence only after other trades work has been substantially completed and areas are cleaned out. Areas shall be maintained in clean condition during painting/polishing.

Surfaces to receive paint/polish finish shall be cleaned and prepared as per code of practice and as recommended by paint/polish manufacturer to approval of the CONSULTANT. It shall include required cleaning, sundries, touching, filling, priming, etc. Surfaces to be painted shall be perfectly clean and dry.

If surfaces are not in satisfactory condition for cleaning, sanding, speckling, etc. it shall be reported to the CONSULTANT in writing.

All adjoining areas, surfaces shall be protected with temporary protection to prevent damage from droppings, spray, windblown particles, etc.

Surfaces to receive finishes shall be dry, free from condensation, any extraneous matter and accepted by CONSULTANT.

The contractor shall make good, at no additional expense to the Employer, any failure or damage to appearance due to the substrate not being completely ready for paint/polish application and substrate being rough or unsuitable by previous tradesmen.

Paint/polish shall not be applied to surfaces where moisture content exceeds 8% when measured with electronic moisture meter or 15% when measured with protimeter.

Fitting and fixtures (ironmongery) fixed to wood or steel shall be removed prior to application of paint or varnish.

Follow manufacturer's printed and special instructions if any for mixing and application.

### **15.2.13.2 Scaffolding**

#### **Field samples**

- 1) Install approved paint system on wall surfaces, other interior and exterior components directed by the CONSULTANT.
- 2) Prepare and install area about 10 sq.m. of full surface in required colour, shade, texture, workmanship quality, etc.
- 3) Obtain approval of each paint system for colour, texture, quality and workmanship.

#### **Pre-installation co-ordination**

- 1) Discuss sequence and scheduling, installation procedures with other trade.
- 2) Review requirements and conditions for successful performance.
- 3) Review environmental and ventilation requirements.
- 4) Review surface conditions and acceptability from paint manufacturer's requirements.
- 5) Review project specifications and instructions of CONSULTANT.

### **15.2.13.3 Surface Preparation**

#### **• Wood Work**

Work shall be carried out to specifications as in IS 2338 Part I and II. The system shall be installed as per the schedule for finishing and shall be as per table of IS 2338 Part II "Schedule for finishing wood or wood based materials"

- 1) Wood to be painted / polished shall be seasoned and free from discoloured sapwood and from large resinous or loose knots.
- 2) Nail shall be punched well below the surface to provide a firm key for stopping.
- 3) Mouldings shall be cleaned and removed.
- 4) Flat portions shall be smoothened.
- 5) Any knot, resinous streaks or bluish sapwood shall be treated with two coats of pure shellac knotting, applied thinly and extended to about 25mm beyond the actual area requiring treatment.

- **Ferrous Metal Surface**

Ferrous metal surfaces shall be painted in accordance with IS 1477 Part I and II. Partly or fully pre-fabricated material shall be pre-treated only at the factory with specifies primers after the required and controlled surface preparation. The painting system shall be as per table of IS 1477 Part II "Painting Schedule for Ferrous Surfaces"

- **Preparation Of Surface**

It is most important to prepare the surface as per the various methods detailed in IS 1477 Part I and IS 6005 depending upon the material to be painted/polished and maintained.

Types of method employed are

- 1) Petroleum solvent cleaning
- 2) Trichloroethylene cleaning
- 3) Alkaline cleaning in process tank
- 4) Emulsion cleaning
- 5) Electrolytic and steam cleaning
- 6) Mechanical cleaning (scraping)
- 7) Flame cleaning
- 8) Sand-blasting or shot blasting
- 9) Chemical cleaning (Pickling)

The best methods shall be used at the respective locations:

- 1) All structural steel shall be sand or shot blasted at site.
- 2) All pre-fabricated and primed materials shall be mechanically cleaned.
- 3) All galvanized steel products shall be cleaned and washed with etching or wash primer.

- **Clear Finishes For Wood Surfaces.**

Clear finishes shall be applied to wood and wood based interior surfaces. They shall be carried out as per IS 2338 part I. The schedule off finishes shall be as per table of IS 2338 part II "Schedule for finishing wood or wood based materials".

### **15.2.13.4 Application**

- **Painting**

The paint system shall be installed as detailed in table of IS 2395 part II "Schedule for painting (New Calcareous Surfaces Interior) " or as specifically instructed in writing by CONSULTANT along with approval.

Other general points and steps to be followed are

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- 1) Surfaces shall be painted when their moisture content is within manufacturers recommended level.
- 2) Paint shall be applied evenly and thoroughly using clean brushes, spraying machines, tools, plants, etc. They shall be maintained and serviced as specified therein. All materials shall be applied by skilled tradesmen.
- 3) Each succeeding coat of paint shall differ slightly in colour from the preceding coat.
- 4) Specified coat of paint should be completed on an entire floor or area at a time.
- 5) Apply materials at rate not exceeding that recommended by paint manufacturers for surface being painted.
- 6) Drying time between coats shall be as per manufacturer's recommendations.
- 7) To remove visible defects from 1.5 m distance on the surfaces, clean with approved solvent between coats.
- 8) Finish coats shall be smooth, free of brush marks; streaks, laps or pile cap of paint skipped or missed area.
- 9) Only after inspection of completed coat, additional coats if necessitated shall be applied. Number of coats applied shall be determined by considering inspected coats of paints.
- 10) Minimum dry film thickness should not be less than that specified. It shall be recorded by wet film thickness gauge after application of each coat.
- 11) Make edges of paint adjoining other materials or colours clean and sharp without overlapping.
- 12) Where surfaces are specified to receive factory applied primer compatible with finish coats, primer coats may be omitted.
- 13) Back primer exterior and interior finish carpentry and joinery with material specified for prime coats, without runs on face finish cut edges just prior to installation.
- 14) Entire surface (wall or portion) shall be refinished to nearest internal or external corners if portion of finish is damaged or unacceptable.
- 15) Paint systems and/or materials offered for approval shall comply with the minimum dry film thickness requirements. Specified therein. Paints shall be factory mixed and blended ready for use, except for stirring.

### • **Finishing To Wood Surfaces**

#### **Filling**

- 1) Filler conforming to IS 345 shall be used to level off, to make smooth, to prevent the excessive penetration of the finish and to fill the open cells.
- 2) For special stain effects colour fillers shall be used.
- 3) On fine textured woods having minute pores that do not require filling, thin varnishes, lacquer or shellac may be used.
- 4) Filler or stain filler shall be applied by hand using Hessian or jute rags cross the grain. The filled surfaces shall be dried preferably overnight and smoothed with abrasive paper.

#### **Staining**

Staining of wood shall be restored to create special effects for subsequent clear finish.

Stains used shall be water based, spirit based or oil-based as approved by the CONSULTANT according to the purpose and location.

Surfaces shall be scrupulously clean and free from greasy finger marks.

Small cracks or nail holes shall be stopped with fine plaster of Paris or suitable stopping.

Stains may be applied by brushing and wiping or spraying. Application shall be liberal but without over-staining that may spoil the stained surface.

### **Sealing**

A suitable seal shall be applied on the filled and sanded surface to prevent absorption by the wood of successive coats of finish and to seal stain and filler and thus preclude their bleeding into the finished coat.

When fully dry, the surface shall be sanded taking care not to cut through at corners and edges. Dust shall be blown off and the surface wiped with a clean rag.

### **Varnishing**

Surfaces to be varnished shall be prepared to produce a smooth, dry, matt surface.

Previous coats or stains, if any, shall be allowed to dry and rubbed down lightly, wiped off and allowed to dry.

Varnish shall be applied liberally with a brush and spread evenly over a portion of the surface with short, light strokes to avoid frothing

Excess varnish should then be scrapped out of the brush and the first section be crossed, recrossed and then laid off lightly. Too much or too little varnish left on the surface will mar the appearance of the finish. Once the varnish begins to set, it shall not be retouched. If there is any mistake, the varnish shall be removed and redone.

Sufficient time shall be allowed in subsequent coats for the previous coat to harden and dry.

### **Oil bound distemper**

The surface shall be prepared as specified above. A primer coat of either cement primer or an Approved distemper primer shall be applied, after the uneven surfaces have been leveled with putty.

After the primer coat has dried, the surface shall be lightly sand papered and dusted to make it smooth to receive the distemper.

Distemper shall be prepared as per the directions of the manufacturer and confirming to the shade approved. It shall be applied in specific coats, taking care to allow for drying of each coat before subsequent coats are applied.

### **Water proof cement paint**

The surface shall be prepared as specified above and thoroughly wetted with clean water before water proof cement paint is applied. The paint shall be prepared strictly as per the manufacturer's specifications and in such quantities as can be used up in an hour of its mixing, as otherwise the mixture will set and thicken, affecting flow and finish. The paint thus prepared shall be applied on clean and wetted surface with brush or spraying machine. The solution shall be kept stirred during the period of application. It shall be applied on the surface which is on the shady side of the building so that the direct heat of the sun on the surface is avoided. The completed surface shall be watered after the day's work. Number of coats shall be as specified in the item.

### **Painting, Oil / Enamel/Plastic Emulsion / Melamine polish etc.**

Ready mixed oil paint, flat oil paint, plastic emulsion paint, ready mixed synthetic enamel paint,

aluminium paint etc. shall be brought in original containers and in sealed tins. If for any reason thinner is necessary, the brand and quantity of thinner recommended by the manufacturer or as instructed by the Consultant / Engineer in charge shall be used. The surface shall be prepared as specified above and a



coat of approved primer shall be applied. After 24 hours drying approved or specified quality paint shall be applied evenly and smoothly. A filler putty coating may be given to give a smooth finish. Each coat shall be allowed to dry out thoroughly and then lightly rubbed down with sand paper and cleaned of dust before the next coat is applied. Number of coats shall be as specified in the item and if the finish of the surface is not uniform, additional coats as required shall be applied to get good and uniform finish at no extra cost. After completion no hair marks from the brush or clogging of paint puddles in the corners of panels, angles of mouldings etc. shall be left on the work. The glass panes, floors etc. shall be cleaned of stains. When the final coat is applied, if directed, the surface shall be rolled with a roller or if directed, it shall be stippled with a stippling brush.

#### **Melamine polish**

Surface shall be cleaned. All unevenness shall be rubbed down smooth with sand paper and well dusted. Knots if visible shall be covered with a preparation of red lead and glue. Resinous or loose knots and gaps shall be filled with seasoned timber pieces and made level with rest of the surface. Holes and indentations on surface shall be filled with putty made of whiting and linseed oil. Surface shall be given a coat of filler made of 2.25kg of whiting in 1.5 litre of methylated spirit. Mixture or polish with melamine lacquered with desired stain and matt finish two coats over one coat of filler and one coat of sealer. The thickness of each coat shall be a minimum of 20 to 25micron. The melamine shall be sprayed using a compressor machine in a uniform and even method so as to achieve a uniform and even look. The surface shall then be finished by rubbing emery powder/paste over the melamine sprayed surfaces. The contractor shall be fully responsible to ensure full safety of the polishing person during execution. He shall provide the workers with safety masks, gloves etc. All metal surfaces, fixtures etc in the surrounding of the items to be sprayed with melamine coats shall be properly covered with abrow tapes to protect the surface textures of the same. These shall then be removed and cleaned well after the work is completed. Trails of melamine spray liquid should be strictly avoided. The melamine polish shall be of Asian paints, ICI Dulux, Nerolac or equivalent.

#### **15.2.14 Method Of Measurements:**

The works shall be measured in square meters unless otherwise mentioned in the bills of quantities. The method of measurements for the above mentioned works shall conform to IS 1200, SP27 – latest: editions/revisions / alterations and thereon.

## **C.20 Signages**

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### **20.1 Acrylic Sheets**

Acrylic sheets shall be of thickness as specified in the item and of specified shape and size, as the case may be. Panels may be flat or curved. It should be light in weight. It shall be Colourless or colored or opaque, as specified in the item. Colourless sheet shall be transparent as the finest optical glass. Its light transmission rate shall be about 95%. Transparency shall not be affected for the sheets of larger thickness. It shall be extremely resistant to sunlight, weather and low temperature. It shall not show any significant yellowing or change in physical properties or loss of light transmission over a longer period of use. The sheet shall be impact resistant also, sheets should be of such quality that then can be cut, bent and jointed as desired. Solution for the joints shall be used as per the requirement of the manufacturer. The Acrylic sheets shall conform to relevant Indian Standard codes.

## **C.22 Road Development**

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All road construction and development works shall be executed as per the designs of the consultants and shall be as per the guidelines of MORT & H and NHAI specifications.

## **C.18 Fencing Works**

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All the fencing works shall be executed as per the designs of the consultants. The material used for fencing shall be of good quality GI diamond shaped interlocked chain link fencing. The MS members used for the fencing shall be erected firm and straight and shall be embedded in a concrete base of 1:3:6 cement concrete. The chain link shall be stretched and firmly fixed to these MS angle / tubular box sections supports using 5mm thick MS flats. The MS flats shall be fixed in such a way so as to retain the chain link in a stretched shape and firm using MS nuts and bolts of 8mm and 12mm as per designs. The MS sections shall be painted using synthetic enamel paint and the paint shall be applied in two coats over a coat of anti corrosive zinc chromate using brush. The item shall be measured in square meters to the nearest two decimals. Elevational area shall be measured. MS sections shall be paid for separately as per items in chapter C.08 of the Bills of Quantities.

## **C.18 Dismantling And Demolishing**

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### **18.1 Terminology**

**Dismantling:** The term 'Dismantling' implies carefully separating the parts without damage and removing. This may consist of dismantling one or more parts of the building as specified or shown on the drawings.

**Demolition:** The term 'Demolition' implies breaking up. This shall consist of demolishing whole or part of work including all relevant items as specified or show on the drawings.

### **18.2 Precautions & Execution**

The demolition shall always be well planned before hand and shall generally be done in reverse order of the one in which the structure was constructed. The operations shall be got approved from the Engineer-in-Charge before starting the work. Due care shall be taken to maintain the safety measured prescribed in IS: 4130.

Necessary propping, shoring and or under pinning shall be provided to ensure the safety of the adjoining work or property before dismantling and demolishing is taken up and the work shall be carried out in such a way that no damage is caused to the adjoining work or property. The temporary enclosures or partitions shall also be provided, as directed by the Engineer-in-Charge.

Necessary precautions shall be taken to keep down the dust nuisance to the minimum.

Dismantling shall be done in a systematic manner. All materials which are likely to be damaged by dropping from a height or by demolishing roofs, masonry etc. shall be carefully removed first. The dismantled articles shall be removed manually or otherwise, lowered to the ground (and not thrown) and then properly stacked as directed by the Engineer-in-Charge.

Where existing fixing is done by nails, screws, bolts, rivets etc., dismantling shall be done by taking out the fixing with proper tools and not be tearing or ripping off.

Any serviceable material, obtained during dismantling or demolition, shall be separated out and stacked properly as directed by the Engineer-in-Charge within a lead of 50 metres. All materials obtained form dismantling or demolition shall be the property of the Government unless otherwise specified. All unserviceable material rubbish etc. shall be disposed off as directed by the Engineer-in-Charge.

The contractor shall maintain/ disconnect existing services, whether temporary or permanent, where required by the Engineer-in-Charge.

### **18.3 Measurements**

All works shall be measured net in the decimal system, as fixed in its place, subject to the following limits, unless otherwise stated hereinafter.

- i) Dimensions shall be measured correct to a cm
- ii) Areas shall be worked out in sqm correct to two places of decimal.
- iii) Cubical contents shall be worked out to the nearest 0.01 cum.

Parts of work required to be dismantled and those required to be demolished shall be measured separately.

Measurement of all work except hidden work shall be taken before demolition or dismantling and no allowance for increase in bulk shall be allowed.

Specification for deduction for voids, openings etc. shall be on the same basis as that adopted for new construction of the work.

## **18.4 Rates**

The rate shall include the cost of all labour involved and tools used in demolishing and dismantling including scaffolding. The rate shall also include the charges for separating out and stacking the serviceable material properly and disposing off unserviceable material within a distance of 50 metres.

The rate shall also include for temporary shoring for the safety of portions not required to be pulled down, or of adjoining property, and providing temporary, enclosures or partitions, where considered necessary.